SCIENTIFIC AMERICAN

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A WEEKLY JOURNAL OF PRACTICAL INFORMATION, ART, SCIENCE, MECHANICS, CHEMISTRY, AND MANUFACTURES.

Vol. LXXVII.—No. 19. ESTABLISHED 1845. | NEW YORK, NOVEMBER 6, 1897. | $3.00 A YEAR. WEEKLY.

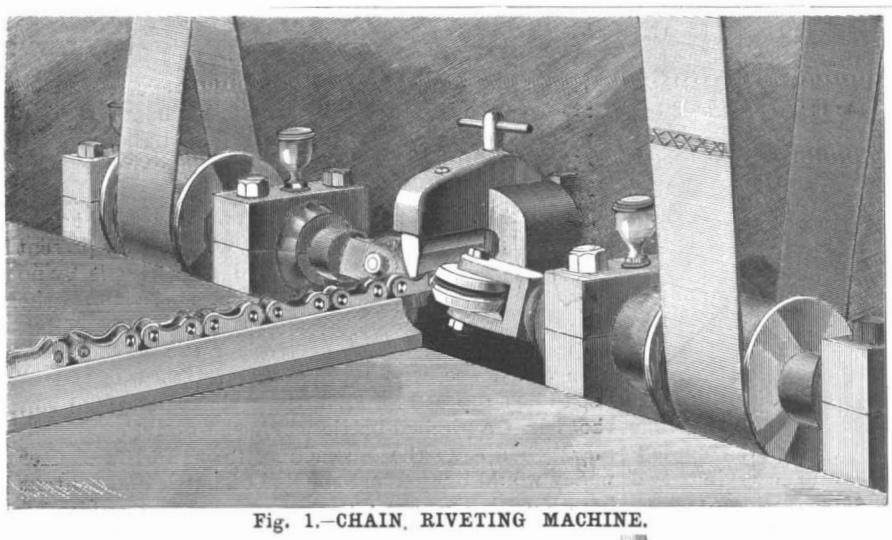


Fig. 1.—CHAIN RIVETING MACHINE.

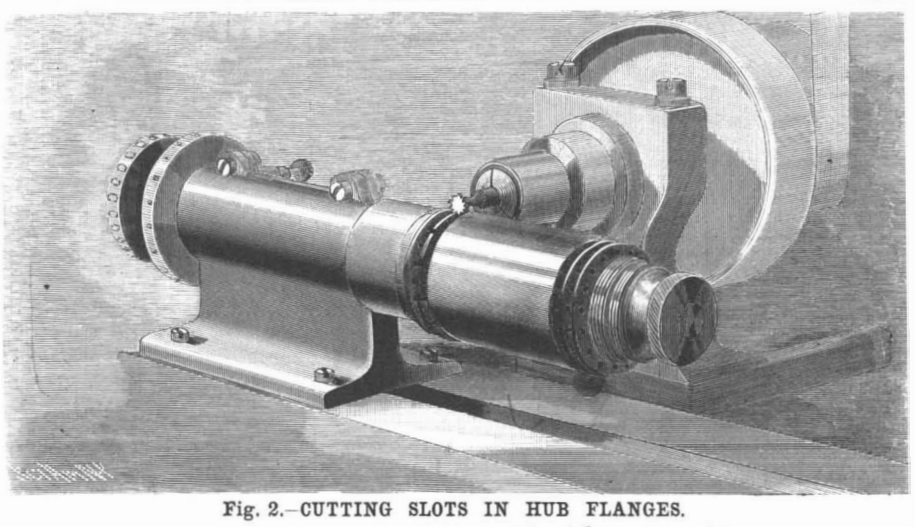
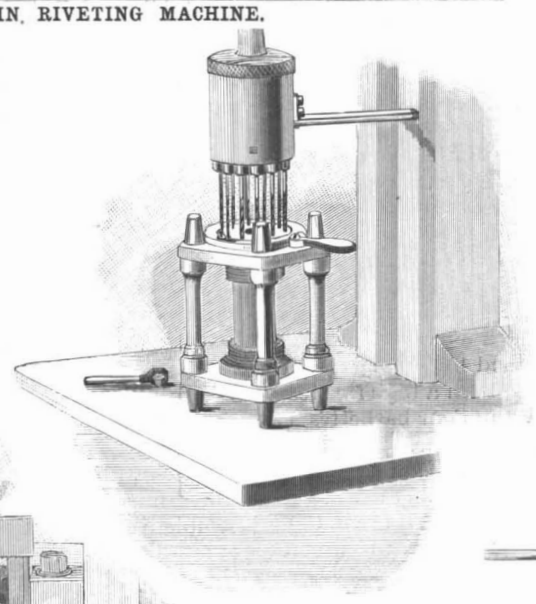


Fig. 2.—CUTTING SLOTS IN HUB FLANGES.



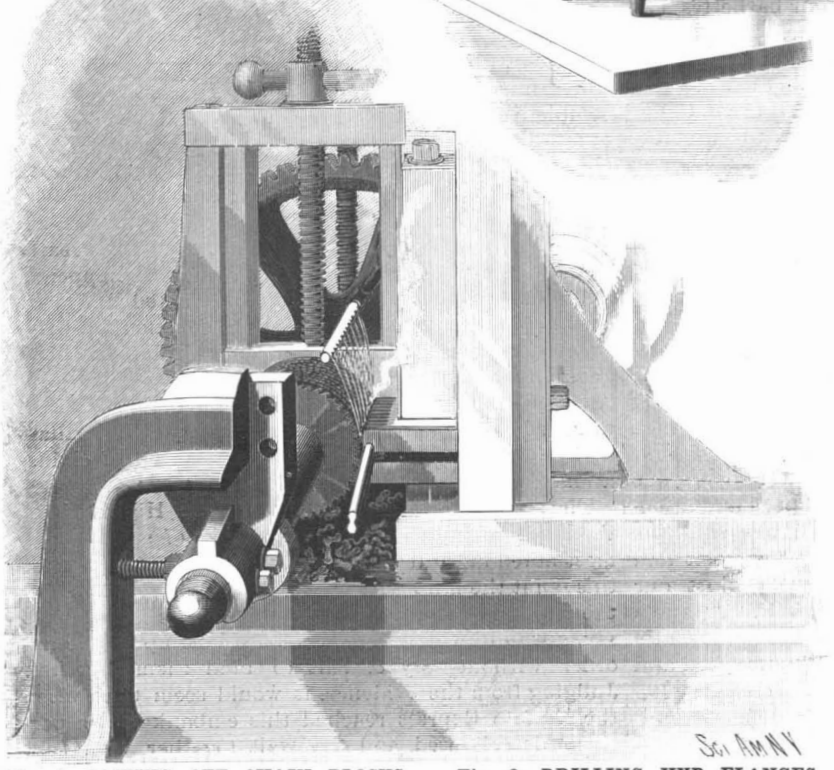


Fig. 5. SAWING OFF CHAIN BLOCKS. Fig. 3. DRILLING HUB FLANGES

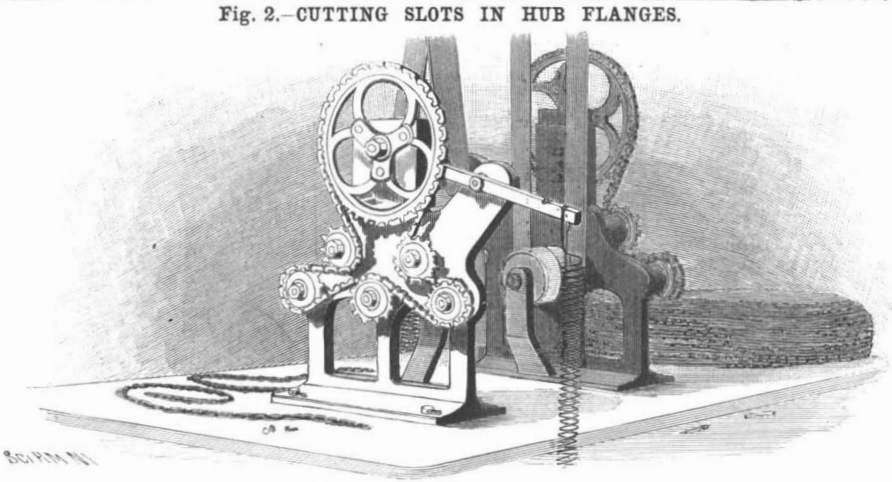


Fig. 4.—CHAIN LIMBERING MACHINE.

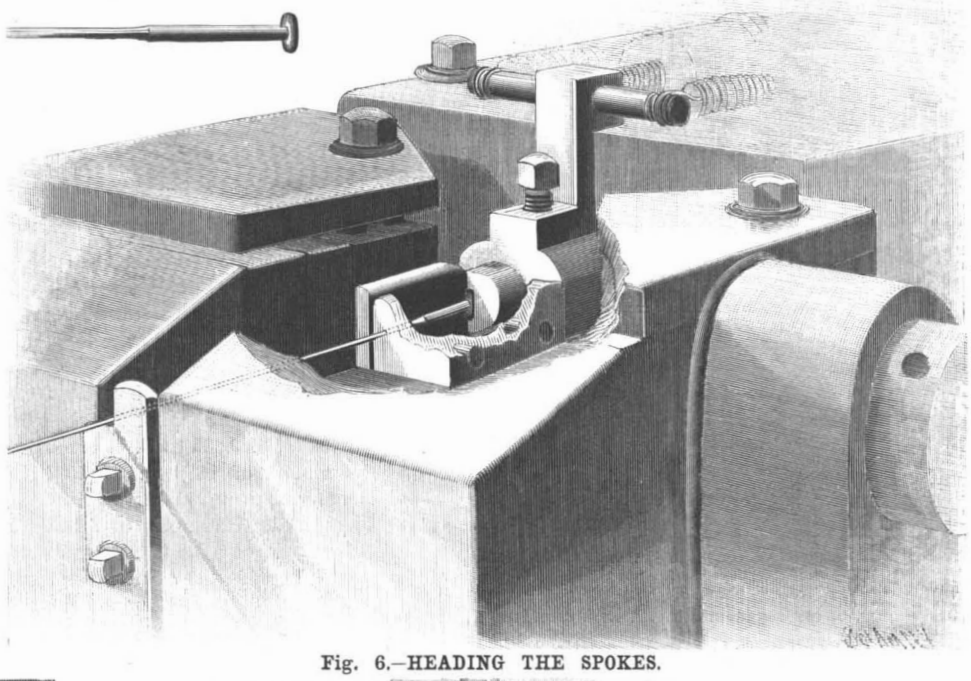


Fig. 6.—HEADING THE SPOKES.

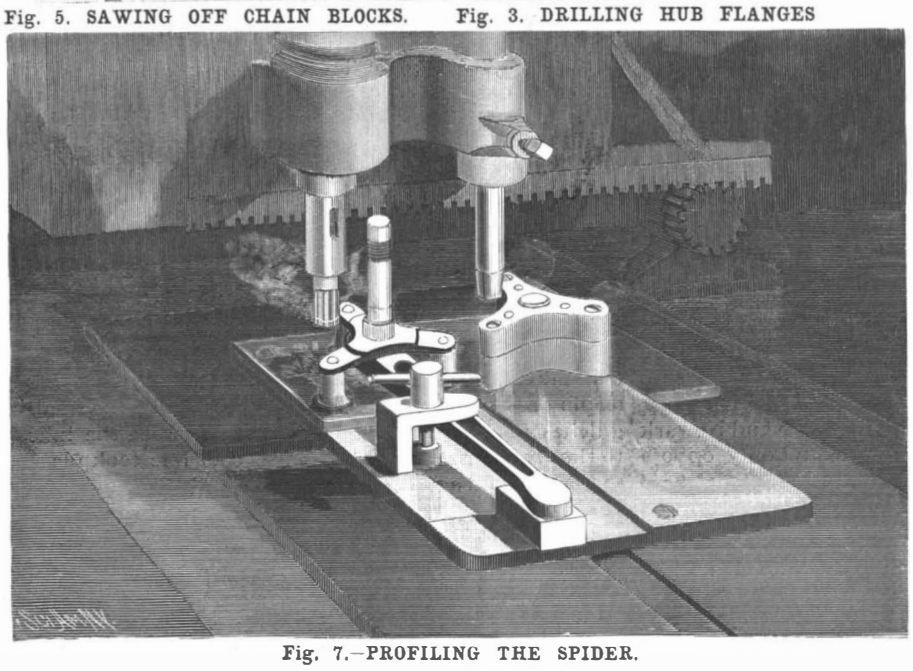


Fig. 7.—PROFILING THE SPIDER.

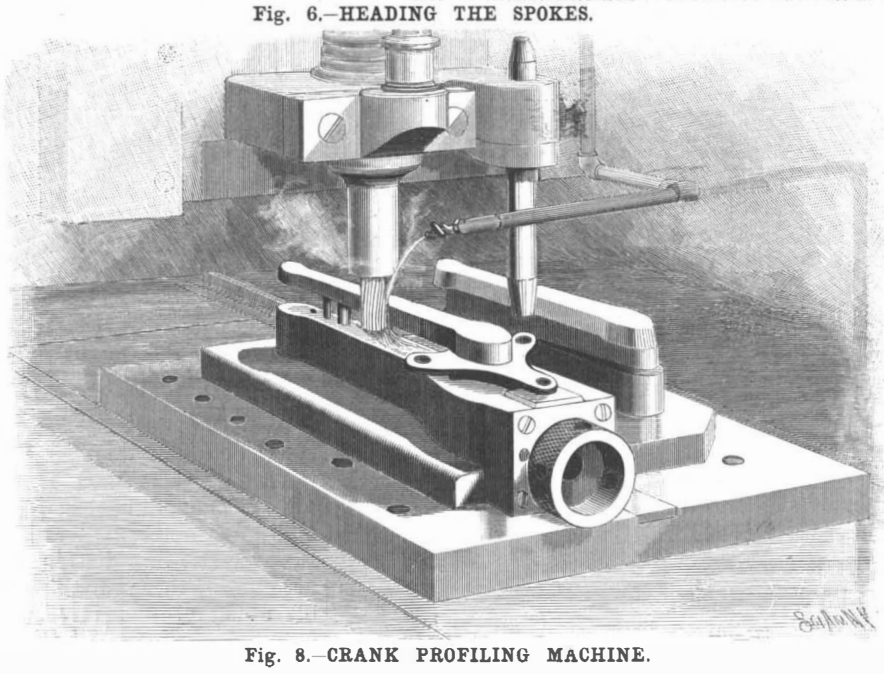


Fig. 8.—CRANK PROFILING MACHINE.

THE PLANT OF A MODERN BICYCLE FACTORY.—[See page 292.]

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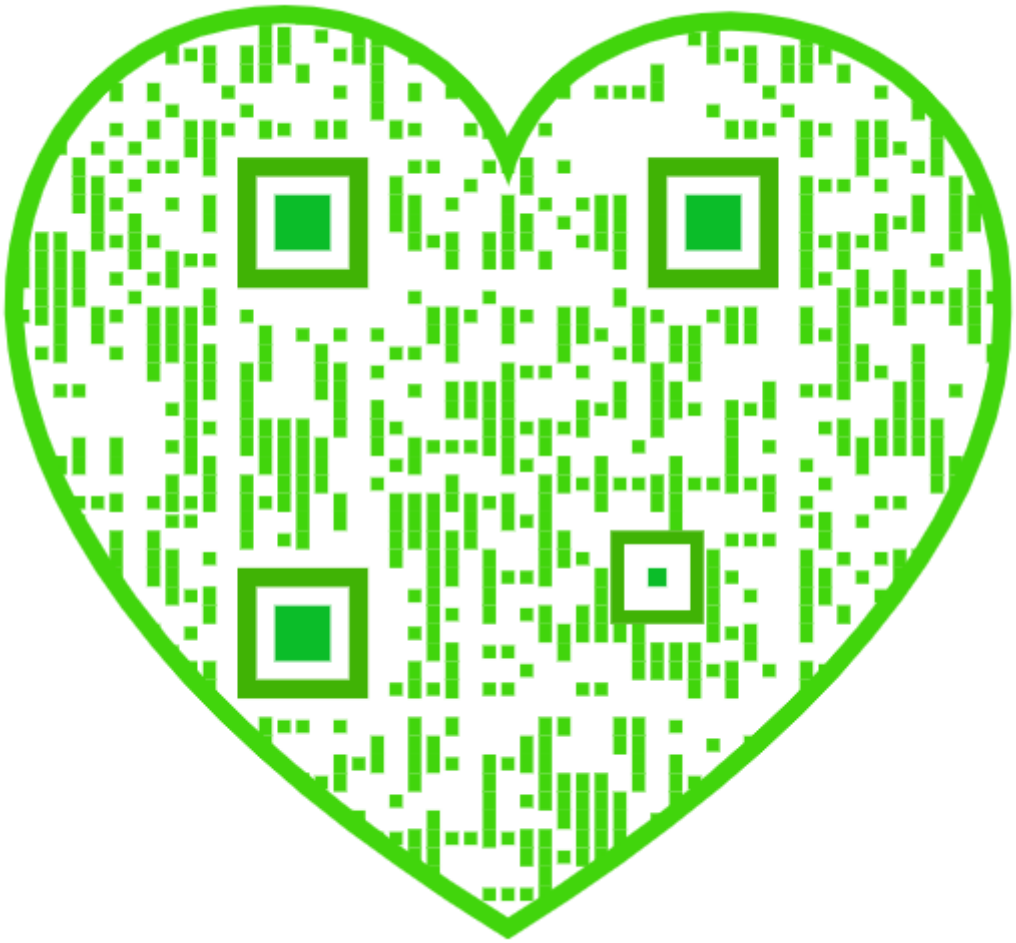

Scientific American.

ESTABLISHED 1845

MUNN & CO., - - - EDITORS AND PROPRIETORS.

PUBLISHED WEEKLY AT

No. 361 BROADWAY, - - NEW YORK.

TERMS FOR THE SCIENTIFIC AMERICAN.

(Established 1845.)

One copy, one year, for the U. S., Canada or Mexico.....**$3.00**
One copy, six months, for the U. S., Canada or Mexico..... **1.50**
One copy, one year, to any foreign country, postage prepaid, £0 16s. 5d. **4.00**
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MUNN & CO., 361 Broadway, corner Franklin Street, New York.

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(Established 1876)

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MUNN & CO., Publishers, 361 Broadway, New York.

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NEW YORK, SATURDAY, NOVEMBER 6, 1897.

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Price 10 cents. For sale by all newsdealers.

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THE NAVIES OF THE UNITED STATES AND SPAIN—A COMPARISON.

In view of the somewhat strained relations which exist between certain sections of the press of the United States and Spain, and the rather thin ice upon which the diplomatic representatives of the two countries are just now venturing, a comparison of the strength of the two navies will have more than a passing interest.

In looking over the lists of the ships, and noting the date of building, one is struck with the fact that both navies, though small, are of modern construction and thoroughly up to date. The period of reconstruction dates from the early eighties, and previous to that time neither nation possessed a navy which, judged by modern standards, was of great practical value. Spain could boast of two or three obsolete types of iron ships, armed with muzzle-loading guns, and a few small cruisers of slow speed carrying breechloaders of the slow-firing type; while the navy of the United States, though numerically stronger, consisted mainly of ships built some twenty years before and during the war between the North and South.

It is difficult to make a comparison of the two navies class by class for the reason that the most important warships of Spain are of a type midway between the battleship and the cruiser, which is not represented in our navy. Of these Spain possesses six ships, known as the Infanta Maria Teresa class, of 7,000 tons displacement and 20 knots speed, with a complete 12 inch belt at the water line and carrying two 11 inch guns as the main armament. In respect to their high speed and unprotected upper works they approximate to the cruiser, while the great thickness of the belt and the barbette armor and the size of the main armament would rank them as second-class battleships.

Comparing the two navies seriatim by classes, we find that the United States has a great preponderance in first-class battleships. Of these she possesses four, with an average displacement of 10,568 tons; average speed, 16·42 knots; thickness of belt armor, 18 inches of Harveyized steel, and a main armament of 13 inch guns. Against this Spain could oppose her one battleship, the Pelayo, 9,900 tons, 16 knots speed, 17¾ inch belt, and armament of 11 inch and 12½ inch guns. The Pelayo is a French built ship, with a high freeboard, and its main battery disposed in four barbettes, two fore and aft and two on the broadside. She is a formidable ship, but would scarcely be a match for either of our battleships, except in a heavy sea, when her greater command would be a considerable advantage.

Spain has no second-class battleships to offset the Maine, 6,682 tons, 12 inch belt, 17·4 knots speed, and four 10 inch guns; and the Texas, of 6,315 tons, 12 inch belt, 17 knots speed, and armament of two 12 inch guns, unless we reckon the Infanta Maria Teresa as belonging to this class, in which case Spain possesses a superiority of four ships. This would go far to offset our advantage in battleships of the first class. The high speed—20 knots—of these ships would give them a great tactical advantage over the Maine and the Texas, and would enable them to choose the fighting position in relation to our Massachusetts or Iowa which would expose them to the least damage.

In the armored cruiser class Spain could oppose one ship of 6,840 tons, 6 inch belt, 20 knots speed and armament of 10 inch and 6 inch guns, and one ship, the Carlos V, of 9,235 tons, 20 knots speed, 2 inch belt and armament of 11 inch and 5½ inch guns, against our Brooklyn, of 9,250 tons, 3 to 7½ inch belt, 21·9 knots speed and armament of 8 inch and 5 inch guns, and New York, of 8,200 tons, 4 inch belt, 21 knots speed and armament of 8 inch and 4 inch guns.

The United States possesses six coast defense monitors of from 4,000 to 6,000 tons, 10 to 13 knots speed, and armament of 10 inch and 12 inch rifle guns. Spain has none of this class of ship, unless two obsolete iron vessels, the Numantia and Victoria, of 7,300 tons and 8 and 10 knots speed, armed with muzzle-loading guns, be included.

In the protected cruiser classes the United States leads with the two commerce destroyers, Minneapolis and Columbia, of 7,357 tons, 23 knots speed and great coal endurance. Spain has no warships answering to these, and neither her merchant marine nor navy could furnish a sea-going vessel that could overtake them upon the high seas. The Olympia, though not so large or fast, is more formidably armed, carrying 8 inch and 5 inch guns; at the same time she is credited with the high speed of 21·69 knots. Spain has no ship answering to the Olympia.

To the 4,500 ton cruisers of the Baltimore and Newark types, of which we have six, Spain could only oppose the Alfonso XIII, of 5,000 tons, and the Lepanto, of 4,826 tons, both of 20 knots speed and armed with 6·2 and 7·8 inch guns and a battery of 4·7 rapid fire guns. The superior size and delivery of shell fire from the rapid fire guns of these two ships would make them formidable antagonists of any two of the six boats above named.

The United States also possess five cruisers of from 3,000 to 3,700 tons, and three of 2,000 tons, most of which have a speed of 19 knots and are armed with rapid-fire guns. To these Spain could oppose five cruisers of from 3,000 to 3,300 tons with a speed of from 14 to 17½ knots. The latter cruisers were built between 1879 and 1887 and are not so fully up to date as our ships, which were built in the nineties and carry rapid-fire guns.

The United States has seventeen gunboats and smaller cruisers of between 1,000 and 1,750 tons displacement and from 12 to 17½ knots speed, as against four of the same class in the Spanish navy which range in displacement from 1,030 to 1,130 tons and are of 14 and 16 knots speed. Spain has also eighteen gunboats of about 550 tons displacement and from 11 to 20 knots speed, according to their date of construction.

Spain possesses two torpedo boat destroyers, fourteen first-class and three second-class torpedo boats, whereas we have three destroyers built and building, and eighteen torpedo boats under construction or completed, with one submarine boat.

From this brief review of the two navies it is evident that Spain is an antagonist who, in the present stage of naval affairs in the two countries, is by no means to be despised. Although she is second to the United States both in the number and power of her ships, her fleet would be effective for the class of warfare which she would probably elect to wage. It is not to be supposed for an instant that she would run the risk of a pitched battle where she would meet such mighty ships as the Massachusetts or the Iowa. Her policy would be to avoid the line of battle and content herself with depredations upon our seacoast cities and our commerce. The great speed of her 7,000 ton armored cruisers would enable them to elude our battleships, and the range and great weight of the 11 inch guns which they carry would prove terribly destructive in long range bombardment.

If a war should prove to be protracted, the delay would be in favor of the United States, as we should soon put in the water the five first-class battleships and the torpedo boats now under construction; and this would give us a powerful preponderance. As matters now stand, however, Spain would undoubtedly be able to maintain for some time a fierce and destructive naval war.

THE DISASTER ON THE NEW YORK CENTRAL RAILROAD.

The fatal wreck of the Buffalo Express on the New York Central Railroad will go on record as one of the worst disasters in railroad history. In the practically complete demolition of the train, and in the long list of fatalities, it possesses all the features which used to characterize the all too frequent accidents on the flimsy pioneer railroads of an earlier day; and the profound sensation which such a calamity always produces on both the lay and professional mind is, no doubt, greatly intensified by the fact that in this case it has happened upon one of the most solidly constructed and best equipped railroads in the world. In common with the Pennsylvania Railroad the New York Central has been generally accepted as the representative railroad of America, and the fame of its four-track line with its hundred-pound rail, heavy ties, broken stone ballast and solid roadbed has reached every corner of civilization.

The scene of the accident lies in the Highlands of the Hudson, and therefore in the midst of some of the most noted natural scenery of that famous river. At this point the lines are carried on an embankment on the outside of which is a dry retaining wall, that is to say, a wall in which the stones are laid upon one another without any cement to bind them together. Judging from the evidence, it would seem that when the Buffalo Express reached this embankment a portion of it collapsed, and the wall, together with that half of the roadbed covered by the southbound track, slid off sideways into the river. The engine and seven cars, including three sleepers, plunged into the river, with the result that a score of passengers lost their lives, chiefly by drowning, and a large number of others were injured.

Travelers who have passed through the Hudson Valley at this point will remember that the river is closely hemmed in by the mountains and foot hills, which often descend precipitously to the river or slope to the water's edge and beneath it at various angles of inclination. In some places, the roadbed through the Highlands consists largely of "cut" or "fill," that is to say, it is either cut from the hillside or consists of an embankment hugging the shore line at the base of the sloping rock, or thrown across the mouths of the small gulches and valleys which run down between the hills to the river. The construction of this line took place so many years ago that accurate records are not available; but that the engineers met with serious difficulty in the Highlands is probable, judging from the experience of the builders of the New York, West Shore and Buffalo Road along the opposite bank of the river. Here the dip of the rock beneath the river was frequently so steep that the rock embankment and even the cribwork could not obtain a foothold, and slid off bodily into the river. It became necessary to span

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such places with costly steel bridges, two of the most notable of which are located respectively below Cozzens' Hotel and just below Fort Montgomery. The former is 210 feet long and the latter 290 feet, and they are only two instances out of many where this expedient had to be used. Illustrations of this work and a description of the difficulties of railroad building in the Highlands were given in the SCIENTIFIC AMERICAN of January 26, 1884.

We refer the reader to these facts because they suggest a probable explanation of the recent disaster on the opposite side of the river. An examination of the site shows that the natural surface of the rock dips abruptly toward the river. The original single track roadbed was constructed about half a century ago. Subsequently a second track was added on the river side and a retaining wall, laid dry, was built up, which acted both as a sea wall to protect the embankment from the wash of the river and as a retaining wall to hold the material of the roadbed in place. That it had to do the work of a retaining wall is evident from the fact that the filling was carried up to the top of the wall, which would therefore be subject to the lateral thrust of the embankment.

The fact that the embankment has carried the traffic safely for forty years has led the company to suggest that some violent external cause, such as a derailed engine or dynamite in the hands of malicious parties, caused the wreck. But while the long continued stability of the roadbed makes its sudden collapse more puzzling, it cannot be taken as proof that the wall carried a sufficient margin of stability through all these years. If the friction between the roadbed filling and the sloping surface of the underlying rock was sufficient, but only just sufficient, to hold the embankment in place, it only needed the saturation of the material by exceptionally high tides—such as were occurring at this time—and the concussion of a heavy express train to start the slide.

The New York Central holds a well merited reputation for the excellence of its roadbed and equipment. If the careful examination which is being made shows that the wreck was due to the cause above suggested, it is probable that a regard for its own interests and those of the public will lead the company to reconstruct its embankments in all places where the shelving rock may imperil the safety of the roadbed.

AN INTERESTING SOCIOLOGICAL EXPERIMENT.

An interesting sociological experiment has been inaugurated in New York City. The housing of men in moderate and reduced circumstances has always been an interesting and important problem. Many attempts have been made in that direction, but in nearly every instance the buildings have been so arranged that they did not attract a desirable class of people, or the architecture, decoration—lack of decoration—or general effect was to give the house an institution-like appearance, with no semblance of refinement, comfort or home. Mr. D. O. Mills was interested in this problem, and at last resolved to venture a large fortune in the erection of a superb hotel for men with small incomes. In the beginning it must be said that there is no charity connected with "Mills House No. 1" on Bleecker Street, New York. The man pays for what he gets, but unlike the frequenter of the ordinary lodging house he gets all he pays for. He has a clean, comfortable room, furnished with a well appointed bed, the floor carpeted and the windows curtained and shaded, for twenty cents a night. Well equipped lavatories, shower baths and luxurious reading and smoking rooms are at the disposal of the guests of the house without extra charge. A good restaurant furnishes meals at the lowest possible price.

Lodging houses in the lower part of New York will not suffer by the opening of the Mills House, because the class of men who frequent them will not be entertained there, but it is expected there will be enough men in moderate circumstances who desire a comfortable home at a minimum price to fill the 1,560 rooms which the house contains. So satisfied is Mr. Mills of this that he is now erecting on the east side a similar building at Rivington and Clinton Streets. Mr. Mills, who is a very successful man of affairs, may be trusted to make no failure in an investment of this kind. Unfortunately, philanthropy is usually divorced from business principles, and the mischief that this does is incalculable, and the result is often that the masses are pauperized, whereas they might be benefited and made self-respecting by enabling them to help themselves. The use of wealth for bettering the conditions of life under such circumstances as will secure to capital its due return is a beneficent experiment which has hitherto been imperfectly tried in New York or elsewhere.

The Mills House No. 1 has a frontage of 200 feet on Bleecker Street. It is ten stories in height and is built of white brick and Indiana limestone. The architect is Mr. Ernest Flagg, who has been entirely successful in designing this hotel. The house is built in two parts, each in the form of a hollow square with two courtyards reaching to the top and ending in skylights. These courts are lighted and heated and comfortable chairs are provided, and each court is ornamented with palms and plants. The windows of the sleeping rooms on the court give light and air, and are provided with grilles and lace curtains, no window glass being used. The rooms on the outside of the building have windows and curtains. The various floors are reached by means of elevators. The rooms are, of course, very small, just large enough to contain a bed and a chair. They are all separated, however, and are lighted over the partition, there being no lights in the rooms. Though the rooms are not luxurious, they are very comfortable. No better bedding can be found in any hotel in New York. Lockers in the basement allow for the storage of the effects of the guests.

The entire front on Bleecker Street is occupied by a series of tastefully decorated parlors which would not disgrace a first-class hotel. A large collection of well-selected books is already in place. Great washrooms are provided with hot and cold running water. The most modern form of baths with hot and cold water are free to all guests. A laundry is provided in the house, and the men may, if they desire, wash their own clothes, facilities being provided for this purpose. The dining room is in the basement and is intended to furnish cheap meals of a good quality.

The Mills House No. 1 was opened on Wednesday, October 27, in the presence of a large number of invited guests. The exercises included a prayer and address by Bishop Potter, of the Diocese of New York, and addresses by Ex-Mayor Abram S. Hewitt and Dr. Chauncey M. Depew. They all spoke warmly in favor of such a use of capital, which does not pauperize old or young men, but which tends to make them self-respecting. The erection of a building of this kind is indeed the truest kind of philanthropy.

AN URGENT PATENT OFFICE REFORM.

We recommend to the careful perusal of our readers the admirable letter upon the question of Patent Office reform which will be found elsewhere in this issue. The high authority from which it proceeds and the unanswerable arguments with which it abounds should serve to bring home to the inventors and manufacturers of the country the urgent necessity for combined action, with a view to securing the necessary reforms at the forthcoming meeting of Congress.

The wearisome delays of which such correspondents as Mr. Heath have from time to time complained are not more harassing to the inventor than they are to the various Patent Office officials, whose hands have been tied and whose best efforts have been crippled by the parsimonious policy of Congress in the matter of appropriations. This parsimony would be more intelligible if the Patent Office were a losing investment for the government; but in view of the fact that this department is netting the government a clear $300,000 a year and that there is a neat surplus of $5,000,000 to the credit of the Patent Office in the Treasury, the reluctance of Congress to grant the modest requests of Commissioners for an increased appropriation is a crying injustice both to the inventors and the overworked staff of the office.

The request for more generous appropriations is so reasonable that the failure of Congress to grant it can only, we think, be due to indifference or want of information as to the workings of the Patent Office. The surest remedy will be for the great body of inventors throughout the country to make the matter a personal one—as it surely is—and bring their individual and united influence to bear upon the senators and representatives with whom they are personally acquainted.

In pleading their case and that of the Patent Office—the two are identical—we do not know of any better brief to put into their hands than the clear and forceful letter to which reference is herewith made.

A RECORD PATENT ISSUE.

The simultaneous issue of one hundred and twenty-five patents to a single individual has caused The Patent Office Official Gazette of October 27, 1897, to assume proportions which make it by far the largest of its kind ever issued. Up to this date the largest issue of The Gazette contained 194 pages. The present issue contains 288 pages. In making it up the Norris Peters Company, according to the Washington Star, used 250 reams of paper and made 252,000 impressions, the usual number of impressions for The Gazette being 140,000. To meet the emergency the government printing office had to telegraph for extra type, and sixty extra men were put upon the work.

The increased bulk of the issue is due to the insertion of the batch of 125 patents above mentioned to Milo G. Kellogg, of Chicago, Illinois, who has assigned the whole set to the Kellogg Switchboard and Supply Company, of Chicago.

The application for the first of Mr. Kellogg's patents was filed April 27, 1887, and the others followed at intervals up to March 9, 1895, which is the date of the last of the 125 applications. A remarkable feature is that every one of them relates to the same subject, namely, improved ways of constructing and operating switchboards for telephone exchanges. The final government fee on these cases amounted to $2,500. This constitutes the largest check ever paid into the Patent Office at one time for government fees, and it is almost needless to add that the 125 patents is the largest number ever issued at one time to one inventor.

Apart from the interest which attaches to the Kellogg patents, on account of the features above mentioned, they should serve to remind inventors of a fact which they too often overlook, but which sometimes seriously affects the value of their patents. We refer to the disinclination of the average inventor to file applications for modifications. Too often they are content to lay stress upon a particular form of the device, and merely make mention of its various modifications, whereas the modifications should form the basis of separate applications. It is only in this way that the inventor can secure the most complete protection. Mr. Kellogg has carried out this principle to its fullest extent, and while there will probably be few subjects that will call for anything like the same number of applications, this notable issue is an object lesson which may be commended to the thoughtful consideration of inventors at large.

THE AGE OF WATER POWER.

It is stated that during a recent interview in Canada Lord Kelvin asserted his belief that the time would come when the greater part, if not all, of the waters of Niagara would be utilized for industrial purposes; and that on being asked if he would not regret the loss of the grandeur and beauty of the falls which would result, he stated that in view of the vast industrial benefit to be gained, he would not regret it. Whether the distinguished scientist was correctly reported or not, there are good grounds for believing that the future will see the new, or rather newly developed, source of energy utilized for industrial power purposes to a degree that will make it only less universal than coal and the steam engine. Time was when water was the leading source of energy for the power necessary to drive the machinery of mills and factories; but the cumbersome and otherwise unsatisfactory nature of the old under or overshot wheel, and the necessity for locating the factories where the power was generated, was a severe drawback to its usefulness. The introduction of steam, with its advantage of being generated wherever the factory might be situated, led to the disuse of water power in almost all cases where coal was available.

The advent of the dynamo and the motor opened a new and wider sphere of usefulness for water power. It gave to it something of the mobility of steam power, and unwound the chains which had tied it down to the banks of the rivers and streams. The water wheel gave place to the turbine, and electrical transmission has carried the silent energy to distant cities and the scattered centers of industry. And who shall place a limit to the distance that may be covered? The recent developments of electrical science point to the possibility of transmitting the stored energy of our rivers and waterfalls to vast distances with but a trifling loss; and with the improvements which analogy teaches us to expect in this comparatively new branch of engineering, we may look for its successful competition with steam in districts far removed from the source at which the power is generated. When this time shall come, it is quite conceivable that Niagara will be depleted of its waters, if the authorities are so utilitarian as to allow it.

The statistics of the present state of the art show that it is advancing with rapid strides. America leads the world with a total installation of over 70,000 horse power. Switzerland comes next with 32,000 horse power. France has 18,000 horse power, and the great power plant at Rheinfelden, Germany, will give Germany the fourth place with about 17,000 horse power. Italy has nearly as much, and Norway and Sweden are each credited with 15,000 horse power. In Great Britain there is a total installation of about 4,000 horse power. These figures suggest that the development of its water power may have a powerful influence in rearranging the centers of industry throughout the world. With the exception of the United States, the best natural water power is located in countries that are deficient in coal beds, and, on the other hand, the leading manufacturing countries, as a rule, are deficient in water power. Switzerland, Italy, Norway and Sweden have in the new system a powerful ally that will assist to bring them well to the front as industrial nations. To the United States, which already possesses enormous deposits of coal, the full development of her natural water power will mean the more speedy coming of that commercial supremacy which is already well within its grasp.

L'ELECTRICIEN, Paris, quotes from the Optician, London, an account of an invention by a man named Wilcox, in which a minute incandescent electric lamp is fastened to a pen near its point in order to illuminate the writing. "A little reflector," it says, "placed behind it, prevents the light from dazzling the eyes and directs it toward the paper. This arrangement . . . may be applied also to a pencil or to any instrument of the same sort."

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A TRIP THROUGH A LARGE BICYCLE FACTORY.

We think that few of the readers of the SCIENTIFIC AMERICAN have an adequate idea of the time and money expended in the manufacture of what is known as a truly high grade bicycle. It is difficult to realize that there are altogether more than nine hundred separate parts to one of these popular machines, and when we see this large number of intricate parts brought together and formed into a symmetrical machine, weighing only twenty-four or twenty-five pounds, and possessing sufficient strength to carry a heavy man over country roads for thousands of miles without sign of failure, we realize the great perfection to which the manufacture of the wheel has attained.

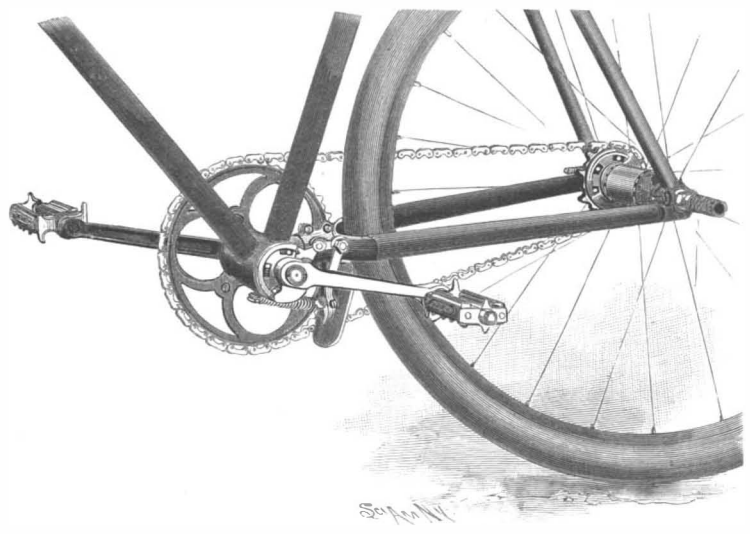

Fig. 9.—THE MORROW BRAKE.

In the earlier days of the industry the bicycle was frequently manufactured in the machine shops of establishments where it formed only a small part of the output, and the bicycle parts were manufactured by the use of such tools as the shop possessed. But as soon as the industry began to assume its present proportions, manufacturers realized that special efforts must be made to keep pace with the demand and meet a competition which was evidently going to be fierce and sustained. They bent their energies to the construction of special tools and machinery for the more rapid, accurate and cheaper execution of the new class of work. So thoroughly have the old methods been changed that, with few exceptions, the best known wheels are now built in factories that are exclusively devoted to bicycle manufacture, and are equipped from end to end with tools that have been specially designed for this purpose.

In the present article we illustrate the design and manufacture of the modern bicycle as carried out at the factory of the Eclipse Bicycle Company, Elmira, N. Y.

It should be noted, in the first place, that this firm builds its bicycles "from the ground up," all such parts as pedals, chains, hubs, cones, shells, and even the saddles being manufactured on the premises. Every nut, large and small, is turned from solid bars of steel, and the distinguishing characteristics of the finished wheel, at which the makers have aimed during the past few years, are strength and durability. In the years when the craze for lightness was at its height, this wheel was maintained at the reasonable weight which is now the standard for the average bicycle. That the policy was productive of a remarkably strong machine is shown by the well known illustration of one of these wheels carrying a load of sixteen men at one time, and, as an evidence of the durability of its machines, the firm quotes with pardonable pride the case of a 20,600 mile ride, in which an Eclipse wheel carried its rider round the entire circuit of the United States.

To follow out the whole process of building a bicycle would require more space than is practicable, and it will be sufficient to select some of the most important and novel features of this particular machine. Attention is drawn to the Morrow hub, a special form of which has been designed to match the direct T-headed spoke which is used on this machine. The desire to attach the spoke to the hub without a bend has led to a variety of ingenious devices, and the accompanying illustrations show the details of one of the most successful efforts in this direction. The hubs, which are made from a solid bar of steel, have flanges turned on each end. The piece is then placed vertically in a gang drill, and the holes for the spokes are drilled through each flange. This machine carries as many drills as there are holes in one flange. The hub is then taken to a milling machine, where a slot is cut from the periphery of the flange to every alternate hole of each pair of inside flanges. These slots are cut so that they will be at right angles to the direction of the spokes. The T-headed spoke is inserted by passing the head down the slot and pushing it sidewise into the opposite hole in the adjoining flange. The heads are formed in three operations on a special machine. The steel wire is first upset, then headed, and finally the bur is sheared off. The advantages sought in this design are strength, ease of adjustment (obviating the necessity of taking the wheel out of the frame, in order to put in a spoke), and a tangential pull which will bring no bending strain on the spoke itself. On the front page of this issue will be found illustrations of the machines specially built for the making of the hubs and spokes.

Illustration No. 6 shows the machine for the upsetting and forming of the head; illustration No. 2 shows the machine for milling slots in the flange of the hub, and illustration No. 3 shows one of the gang drills that bores the necessary number of holes for the spokes, this gang of drills boring the entire number of holes at one operation.

Particular care is taken in the manufacture of the bearings. The cones and cups are turned from solid bars of a special high grade tool steel, and after being carefully tempered in a lead bath, they are drawn to temper in oil and then inspected, ground, and polished. The bearings are rendered dustproof by the method of bevel groovings, which tends to work the dust out of rather than (as is often the case) into the bearings. The adjustment of the crank hanger bearings will commend itself to all wheelmen who have trouble on this score. The cup is provided with a notched periphery, and associated with this is a loose ring with three projecting lugs which reach across the notches and engage recesses in the barrel of the crank hanger. By removing the ring and turning the cup the space of only one notch, the bearing will be adjusted just $\frac{1}{1000}$ inch. The ring is kept in place by a dust cap which snugly incloses the end of the hanger, as shown in the cut.

This company has not followed the fashion of divided crank axles, believing that it is not a sound policy, judged on mechanical grounds. The cranks, which are square, fluted and slightly tapered, are carefully oil tempered. The right crank is formed in one piece with the clover leaf (as the spider is named in this wheel) and the crank axle. Forgings are finished in special machines, two of which are shown at work "profiling" a crank and a spider. The profiler is one of the many ingenious and time-saving machines used in this works. The forging, of whatever design, is fastened to a sliding table on which is fixed a pattern of exactly the same size and shape as the piece is to be. The sliding head carries the vertical cutter and also a vertical pin which bears against the pattern or "former," as it is called. The distance between the "former" and the work being the same as that between the guiding pin and the cutter, it is evident that the latter, in passing around the rough forging, will cut it out to the same profile as the "former."

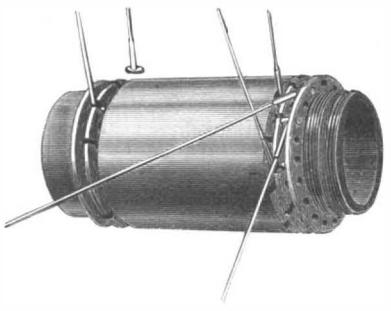

Fig. 10.—FRONT HUB, SHOWING METHOD OF ATTACHING SPOKES.

The Eclipse Bicycle Company favors, as we have said, the continuous axle, the right crank and the axle being in one piece. The left crank is attached by a very neat and effective device, the details of which are shown in Fig. 12. The end of the axle, which is threaded, is milled out so as to leave an inclined surface adapted to receive the flat side of a small key. A small projecting web or key, of metal, is left on the axle, which engages a transverse slot on the key and locks it in the crank. The key is not tapered and it fits snugly in the crank in the same position as the ordinary tapered key; but, unlike the latter, its ends are flush with the surface of the crank. Crank and key are pushed on over the end of the axle and an annular lock nut is then screwed on, wedging the crank tightly in place. It has all the neat appearance and smooth finish of a keyless crank.

Two of our illustrations show the manufacture of the chain, a work to which the company devotes special care. Fig. 1 shows the process of riveting the pins. This is done by two opposite and swiftly revolving pairs of steel disks, the axis of revolution, as will be seen from the cut, being transverse to the axis of the disks. The latter are held in two jaws and are free to rotate on their axes. The inner edges of the disks are beveled so that, as the two sets are pressed together on the ends of the rivet, they upset them and form the desired heads. Another of the many machines concerned in the manufacture of the chain is shown in Fig. 5, where the chain blocks are being sawed wholesale from a bar of steel which has been rolled to the special figure 8 section used by this company. A gang of twenty saws is used on one shaft and the cutting is done so cleanly that the blocks require no further finish than they receive in the friction of the limbering machine. The chains are made from a special grade of chain

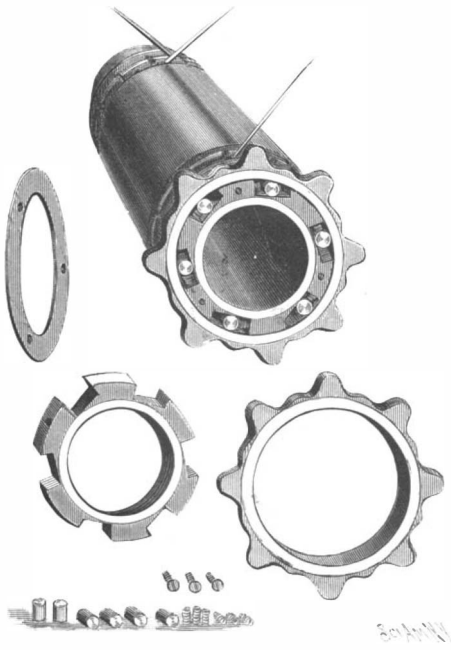

Fig. 11.—THE MORROW HUB AND DETAILS OF SPROCKET CLUTCH.

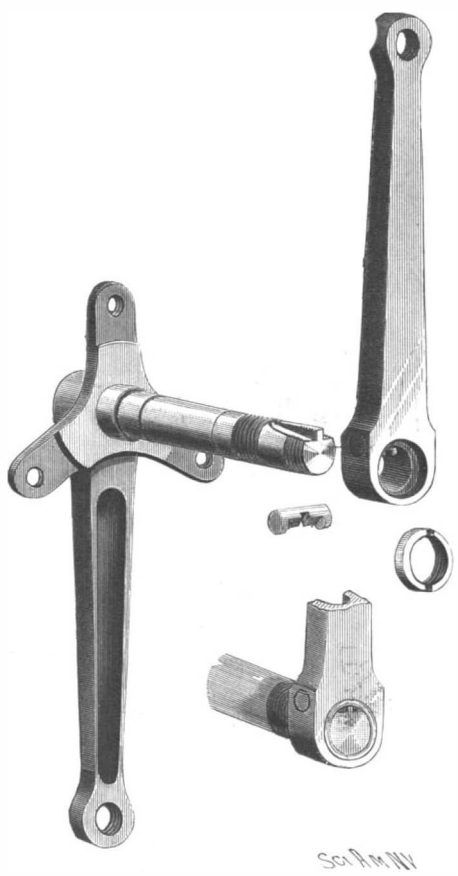

Fig. 12.—CRANK DETAILS SHOWING METHOD OF ATTACHMENT TO AXLE.

Fig. 13.—HANDLE BAR ADJUSTMENT.

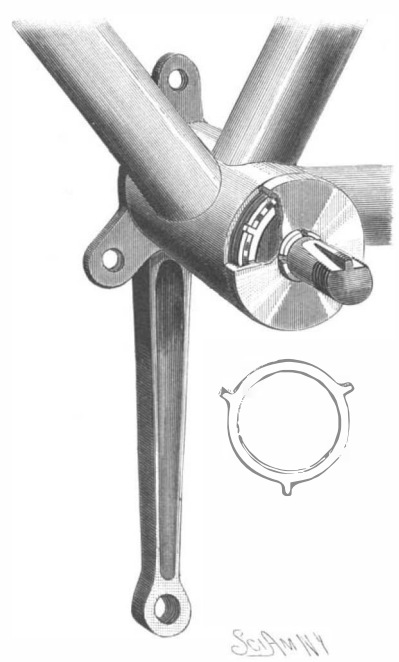

Fig. 14.—ADJUSTMENT OF CRANK HANGER BEARINGS.

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steel, and, after being carefully hardened, they are put in the chain limbering machine, Fig. 4, which consists of a series of large and small sprockets, over which they are run at a speed of 500 revolutions per minute under a tension of 50 pounds. After being tested under a pull of 1,000 pounds in the testing machine, the chain is ready to be put on to the bicycle.

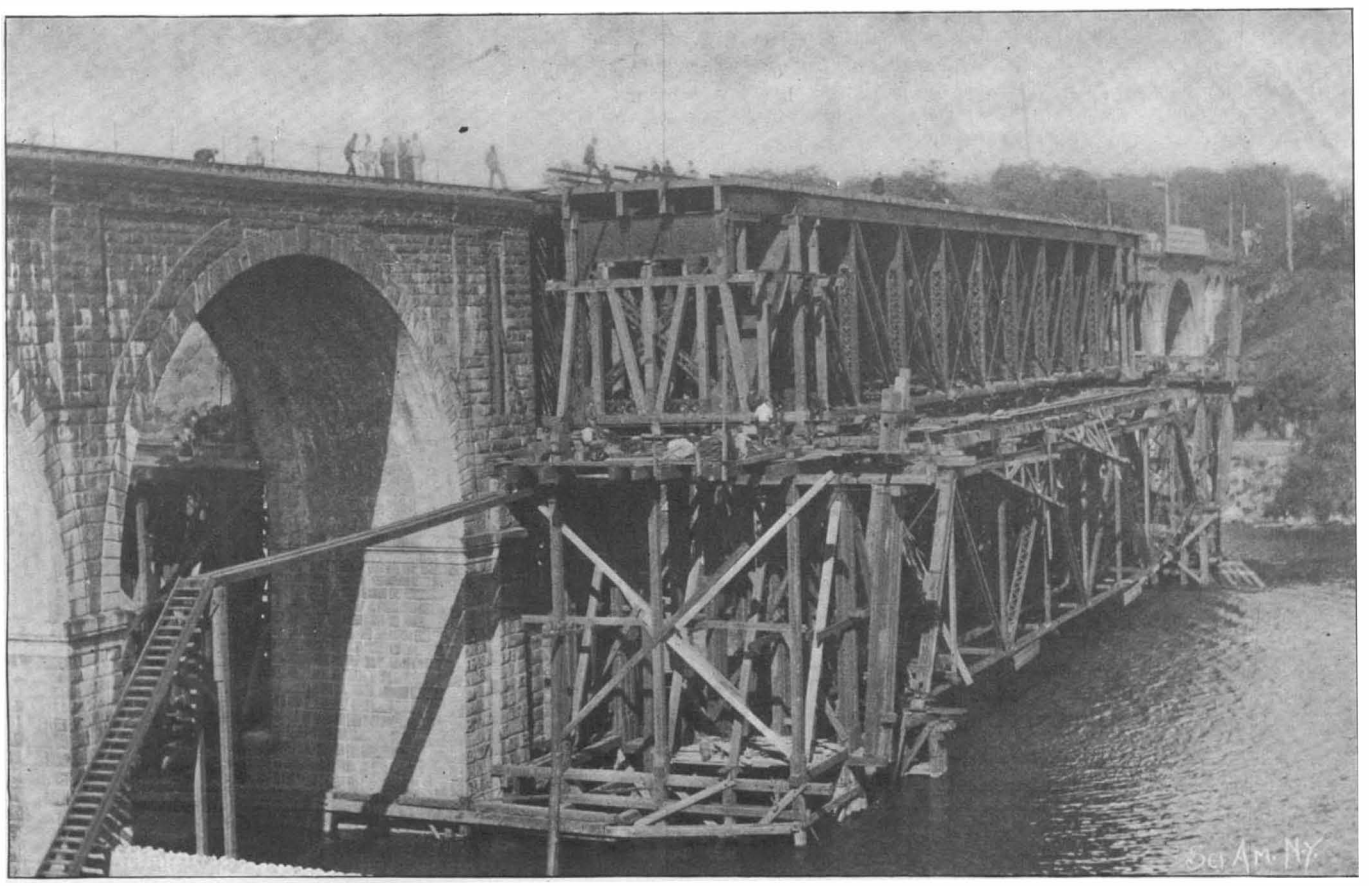
Many of the Eclipse bicycles are fitted with the Morrow brake, which avoids the objectionable features of the ordinary plunger brake, and which gives the wheelman full command of his mount on the steepest hills. Moreover, it enables him to hold his pedals stationary for the purpose of coasting. The mechanism consists of a friction clutch on the rear hub, another clutch on the left crank, and a spoon brake controlled by the latter. In the normal position the rear sprocket clutch is locked and the crank clutch is free. If it is desired to coast, a slight back pressure on the pedals releases the sprocket clutch and allows the rear wheel to run independently of the chain and cranks. To set the brake all that is now necessary is a rather sudden application of back pressure to the pedals. This sets the crank clutch. The external ring of this clutch is provided with a projecting arm which is pivotally connected to an arm on the spoon brake. By pressing down on the pedals the ring is turned backward and the brake is set against the wheel with any pressure desired. It will thus be seen that the rider can coast or set the brake by varying the back pressure upon the pedals, and the leverage is so greatly in his favor that he can stop the rear wheel altogether in cases of emergency.

The sprocket clutch, Fig. 11, consists of a steel disk upon which the sprocket is free to rotate. Around the periphery of the disk are cut out half a dozen rectangular recesses whose bottom faces are not tangent to the periphery but slightly inclined. In each pocket or recess is a hardened steel pin whose diameter is less than the depth of the rear wall of the pocket but greater than the depth of the front wall. The pins are pressed into contact with both the disk and the sprocket by coiled springs. When the sprocket is pulled forward by the chain, the pins also roll forward and become tightly wedged, locking the sprocket to the wheel. On the other hand, when the pull of the chain is reversed, as in back pedaling, the pins are released and the wheel is free to rotate independently of the sprocket. The sprocket is kept in place by a couple of covering flanges, one of which is shown in the accompanying engraving.

The neat appearance and simple handle bar adjustment used on Eclipse bicycles is an attractive feature. The fork head is split and threaded. Upon this are screwed three threaded sleeves, the middle one of which carries a threaded stud. A loose sleeve is passed over the stud and bears upon the outer sleeves above mentioned in such a way that when the nut is tightened the outer sleeves are pressed against one side of the fork stem and the center sleeve against the opposite side, thus securing an even hold upon the handle bar. The device is very efficient and is marked by the neat appearance that distinguishes the various parts of this machine.

We close our notice of this machine and the admirable plant for its construction with a reference to the large number of special tools that are used in the manufacture of all parts, from the minutest to the largest. Before attempting to turn out any number of bicycles, a jig or form is specially made, and in this jig or form is placed whatever part of the bicycle work is being done. All pieces made in such forms will be absolutely alike and interchangeable. After the frames have been entirely completed, they are trued up in another jig or form, to insure that they shall be in perfect alignment.

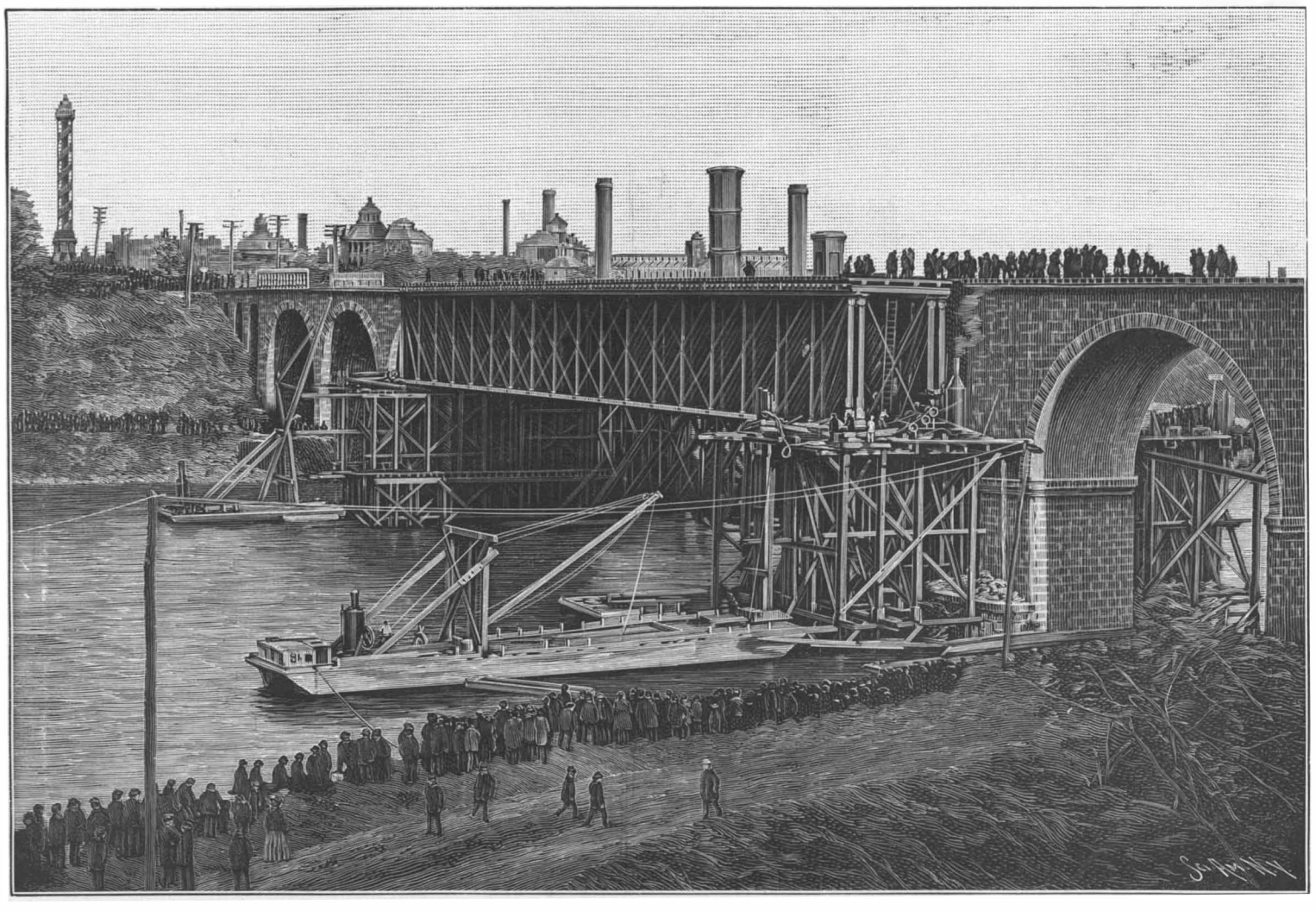
One cannot go through an establishment such as the Eclipse Bicycle Company's and see the close work, rigid inspection of all parts, the vast number of labor saving machines, and not be impressed with the great skill and care, and the elaborate plant, required in the construction of the modern bicycle.



THE NEW STEEL SPAN READY FOR TRANSFERRING TO PLACE.

A RAPID BRIDGE RENEWAL.

A remarkable record for rapid bridge renewal was made by the engineers of the Pennsylvania Railroad Company on Sunday, October 10, when a large iron structure on the busiest part of that road was taken away and a new span put in its place in the remarkable time of nine minutes. This feat was performed on the bridge which crosses the Schuylkill River, carrying the tracks of the New York branch over that beautiful stream just above Girard Avenue, Philadelphia. The approaches of this structure are of the most substantial stone work, and a long metal span stretches across



A RAPID BRIDGE RENEWAL—THE OLD SPAN REMOVED TO TEMPORARY FALSEWORK.

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the river, connecting the arches on either side. The original span was placed in 1868, and as latterly it has not been considered strong enough to sustain the weight of the heavy traffic which is now sent over this line, it was decided to renew it. With this end in view a new span was built on a construction of false work which had been raised on the south side of the bridge. Another false work was also built to the north side. In the river, also to the north, two floats, with a dummy engine on each, were anchored and two other auxiliary engines were placed on the false work at either end of the span. Sunday afternoon was fixed as the most available time to make the exchange of spans, as the business is much lighter on that day. The Chestnut Hill train due at this point at 2:17 was not off the bridge yet when the work of dismantling was commenced at the other end. The track connections were quickly cut, and at a signal both the new and the old spans were raised simultaneously by hydraulic pressure. Another signal was then given for the engines to pull. In exactly two minutes and twenty-eight seconds the change was made and the new iron work slipped into its permanent resting place. It was only the task of a few minutes more to complete the track connection again, and in exactly nine minutes after the passage of the Chestnut Hill train the special car of Superintendent Brooks went smoothly over the bridge without a hitch. Then a couple of heavily ballasted freight trains were rolled back and forth over the bridge tracks as a test, and, having withstood this trial, the structure was declared ready for regular work.

The new span, which is constructed entirely of steel, is 240 feet long, 25 feet wide and 30 feet high. It is known as a Pratt truss or a single intersection quadrangular type of bridge. The old span was of the Linnville or double intersection type, and with its castings weighed 750 tons, while the new span is 200 tons heavier. The two were fastened together and moved at the same time, so that the entire load was 1,700 tons. The new span was built by the Edgemoor Iron Company, but the work of putting it into place was performed wholly by the men of the Pennsylvania Company.

The plans for accomplishing this great work were devised by Joseph T. Richards, the engineer of maintenance of way of the railroad company. They were executed under the supervision of Chief Engineer L. H. Barker and Assistant Chief Engineer L. W. Allibone, of the United Railways of New Jersey division; George Mershon, the veteran master carpenter and bridge builder of the same division, and his son, W. H. Mershon. Several weeks were consumed in the making of these preparations, as the greatest care had to be exercised and every possibility figured out to a nicety. A single mistake meant disaster and possibly serious interruption to the road's business. To avert any such trouble as this, each workman was given a particular duty to perform, and the success of the work attests the excellence with which the orders given were carried out.

Bridges have been moved before by the same methods, but heretofore the change has occurred on very small structures on the less frequented parts of the road. Never before has so massive a bridge been removed in so short a time.

Kite of the Weather Bureau.

The latest achievement of the Weather Bureau's scientists is the successful flying of a new cellular kite which presents a surface of about 70 square feet to the wind and balances itself at a height of one and a half miles. As in the other kites now used for upper air observations, the spruce framework is joined together with wires instead of nails, while the white muslin covering is as durable as the black silk used in the earlier forms of scientific kites, and much cheaper.

The big kite is rectangular in shape like the Hargrave flier, but the details of its construction are very different and it is altogether superior to the Australian kite.

Much time and labor have been expended in condensing the apparatus for recording atmospheric conditions to the minimum weight, which is but 2½ pounds. The anemometer is attached to a truss which projects forward from the topmost support of the front cell. The meteorograph is at present lashed to the lower side of the center truss, but as its being beneath the kite endangers its safety in descending, this delicate instrument is in future to be fastened where the framework will lessen the chances of injury.

Not having time to supervise personally the experiments made with kites, Mr. Potter long ago relegated that branch of the Weather Bureau's work to C. F. Marvin, Professor of Meteorology. The latter gentleman has said in relation to the flying of kites at the very greatest elevation: "If we could employ a string or wire having no weight, and so fine that the wind pressure upon it would be wholly inappreciable, then, as more and more of this wire is paid out to it, the kite would pass outward and upward along the same straight line, retaining always the same angular elevation. A kite could be flown to an unlimited height under such circumstances, provided the wind remained unchanged. Unfortunately, however, we cannot fly kites with wire having no weight and against which the wind will not press; and, in consequence, our actual kite behaves in a very different manner from that described above."

The necessity for using a string which, like the other materials in their respective elements, would combine the greatest strength with lightness, will be plainly seen from the foregoing quotation.

Very fine steel wire was selected because it was strong enough to prevent a kite breaking away, and weighed but five pounds to the mile. As three miles of wire are required for an elevation of one mile, the total weight sustained by a kite at that altitude, including the recording apparatus, would be about 17 pounds, or 25 pounds at a height of one and one-half miles, which is the limit of ascent as yet attained by a Weather Bureau kite.

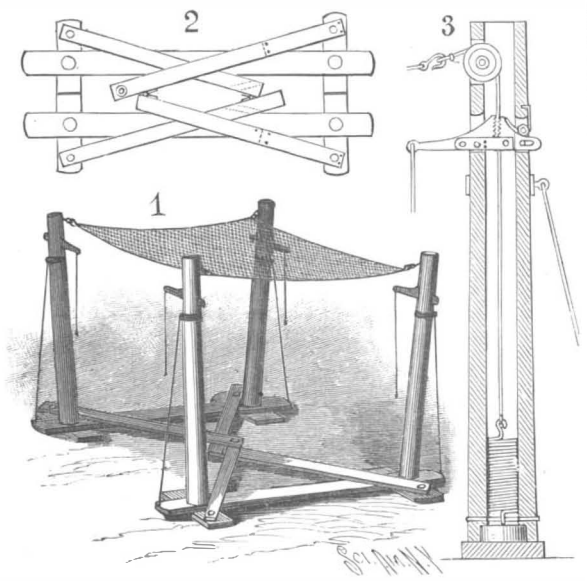
This wire is cut in lengths of 7,000 feet, and after each thousand is reeled out the flight is arrested until the inclination can be determined by focusing telescopes upon a scale marked in black ink upon the inner surface of the white muslin covering.

When a kite has risen above the treacherous undercurrents of air, it is out of danger until, in descending, it strikes the breakers again.

A number of kites are sent up from the flying grounds near Washington every windy day, a small engine being used for paying out the wire.

A NET HOLDER FOR USE AT FIRES.

The illustration represents a life saving device which may be folded to occupy but small space when not in use, but which may be quickly and conveniently set up, as shown in Fig. 1, to support a net, mattress, or bed in position to receive a person jumping or falling from a burning building. The construction is such



ALLING'S NET HOLDER FOR USE AT FIRES.

that the receiving surface yields under the weight of the falling body, the net or bed being thus forced downward, but there is no rebound, the net being afterward restored to its upper or normal position by those present. The improvement has been patented by Samuel A. Alling, of Homer, Minn. Fig. 2 shows the base of the device folded and Fig. 3 represents a vertical section through one of the posts. In the lower part of each post a spring is secured by means of a pin at its lower end, and from the upper end of the spring a cord extends up the hollow post and over a pulley to a hook or clip connection with a net or mattress. Near the upper end of each post are opposite openings, in one of which is fulcrumed a lever having on its inner end gripping teeth, while in the opposite opening is pivoted a spring-pressed gripping arm, the lever and gripping arm forming a clutch through which passes the cord from the spring to the net. This clutch permits the outward movement of the cord as the spring is extended by the force of the body falling on the net, the springs thus cushioning the fall, but the return movement of the cord, or rebound by the springs, is prevented by the action of the clutch in each post. After the body has been removed from the net, however, the clutch in each post is released from engagement with the cord by pulling upon a downwardly extending release cord attached to the outer end of the lever member of each clutch.

What Invention Has Done.

What is it that enables an operative to-day to produce so much more in a less number of hours than he could thirty or forty years ago? It is simply invention, as embodied in the improved machines, tools, processes and appliances that American inventors are constantly furnishing to American manufacturers.

Near Baltimore there was recently erected one of the largest plants in the world for the manufacture of Bessemer steel in all its forms; and, as recently stated by its superintendent, by means of the inventions and improved appliances they have adopted, they are enabled to produce a ton of steel with but one-third of the manual labor required at their other establishment, built twenty or twenty-five years before.

In 1866 steel rails cost $165 per ton. In 1884 they had dropped to $34, in 1893 they were $21 to $24 per ton, and in 1897 even less. See how that has expedited the building of railroads, which now cover the country like a network, and without which modern enterprise could not be carried on. And the same is true of steel in all its forms. So that to-day we build steel bridges, steel vessels, steel cannon, steel frames for our buildings and for farm implements, and use steel nails.

Inventions and improvements have so reduced the cost of steel rails that already, during the year 1897, the United States have sold 100,000 tons to Europe. —Engineering Magazine.

Ant Shelters.

BY GEORGE M. BROOKE.

One morning in early summer, several years ago, I was admiring from a distance a beautiful Virginia creeper, the young and graceful shoots of which, covered with fresh green leaves, adorned the weatherworn panels of an old board fence. A nearer view revealed the young shoots covered with brown aphides (plant lice), attended by busy ants. These were ants belonging to a common species, although I am ignorant of their scientific name. They were small, and dark brown in color, with short, sharp pointed bodies and short legs. The species, when excited or disturbed, has the peculiar habit of bending the abdomen upward to a vertical position; running hither and thither with it thus elevated, so long as disturbed. It is quite common to see these ants traveling on fences, in long lines; some moving in one direction, some in the opposite, passing each other, going and returning. Their nests are found in rotten timber, as in the decayed trunks and stumps of trees, in old fences, or in piles of refuse wood.

While watching the ants and aphides, my attention was arrested by some small gray structures sticking to the panels of the fence. Each was pierced by one or more small apertures. These structures, while not symmetrical, had all more or less the form of flattened domes, varying in width and length from one to one-fourth inch, with an average height of the eighth of an inch. Breaking one open, I discovered within it several ants of the species I saw milking the aphides. Soon I noticed numbers of them running in and out of the apertures of some of the little structures. I was at first declined to believe that these little gray houses were real ants' nests, but I knew from observation that these ants lived in holes and cavities in rotten timber. On close examination, no sacs were discovered, and none but worker ants were visible. All moved slowly and lazily, presenting a very different appearance from the busy little workers one sees running rapidly hither and thither in the proximity of the nest. I was mystified.

Most of the little houses—for houses they seemed to be—were sticking to the panels of the fence. Some were built over the shoots themselves on which the aphides were feeding, affording cover to aphides as well as ants. The appearance was that of a village in miniature. Some, however, were built upon free shoots, waving to and fro in the wind—breezy homes for the small dairymen. Some of the ants, I soon discovered, were engaged in tearing up wood fiber, of which the houses were made, and sticking the pieces together, to build new ones or repair old ones. During a shower or on a rainy day the houses were always quite full; but, when the sun dispelled the clouds and once more shone again, the little builders sallied forth to repair the damage done their frail houses by the passing rain or squall, or to milk the aphides in their pastures on the shoots.

The ants use these structures exclusively as shelters, and my continued observations failed to detect any other use or purpose in their construction. They were kept in constant repair and were used at night and in rainy weather; and even in the daytime served as retreats for those not occupied at the dairies. One broken open during the day seldom failed to reveal several of the inhabitants at home. As the shoots of the creeper grew with the advancing season, and the aphides were transferred gradually further from the shelters, the ants abandoned them and built themselves new ones, nearer the dairies. Those abandoned soon fell to pieces, being washed away by the showers.

The true nest and home of all the ants on the creeper was in a pile of boards, at some distance from the fence—probably some ten or fifteen feet away. I have seen shelters like these since, and on this fence; but never in such numbers as they appeared that season. I have seen them built by ants of this same species, while tending aphides on the tendrils of the grapevine and on the young shoots of the wild raspberry.

No mention of the foregoing facts has ever come to my notice. If they are on record as observed, I should like to be further informed with regard to this subject.—Popular Science News.

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Correspondence.

A Needed Patent Office Reform.

To the Editor of the SCIENTIFIC AMERICAN:

In your issue of October 23, your correspondent, Mr. William G. Heath, in an article entitled, "A Needed Patent Office Reform," has by implication unintentionally done some injustice to the authorities of the Patent Office, and evidently is not fully advised of the many and burdensome limitations by which that office is hampered. Nor is it probable, indeed, that the true state of affairs is generally known to the public.

Mr. Heath, after referring to the fact that four months' delay before office action is taken after filing is not an uncommon thing, remarks that with a surplus of $300,000 accumulated during the past year, and a total surplus to the credit of the office of more than $5,000,000, it would seem that there is no excuse for submitting inventors to such long delays . . . on the ground that the office is overworked, or the force of examiners insufficient, and he very pertinently asks, "Why is that $5,000,000 surplus lying idle when it might be expended in supporting an increased force of examiners, and thus facilitating the work of examination?"

The answer, however, is very simple. The Commissioner of Patents has no power and authority whatever over a single penny of the receipts of the Patent Office. Every cent must, by law, be covered into the treasury of the United States, and the only funds available for the expenses of the office are such as Congress annually appropriates for that purpose, specifying how much must be spent for each branch of the service, and even enumerating the entire office force to a man, prescribing their duties and salaries, and specifying the various amounts to be expended for supplies and other expenditures.

Year after year the number of applications filed for patents has increased, and the field of research which the examining corps must daily traverse has broadened out, its extent being no less than the entire issue of domestic and foreign patents, as well as all technical and scientific literature, in all languages, which forms a mass of printed matter that is growing at a very rapid rate.

Thus in 1886 the office received 35,968 applications; in 1896, 43,982. Up to 1870 the number of foreign patents issued by all countries other than the United States was approximately 358,000, while between 1870 and 1896 1,282,000 were issued; and technical and scientific literature is increasing in geometrical ratio, while no material increase has been made in the office force simply because Congress has not given the Commissioners power to make it.

Year after year successive Commissioners have in their annual reports called the attention of Congress to these matters, and in the strongest language at their command have suggested, recommended and almost implored Congress to afford the necessary relief, but thus far all to no purpose.

I could fill many pages of your journal with their utterances upon this head, were they available. I will merely point out where those interested may read what things have been repeatedly recommended and asked for in vain since the year 1890.

The recommendations for an increase of force divide naturally into two classes:

First, recommendations for an increase of the regular office force.

(See Reports Commissioner of Patents for June 3, 1890, p. 5; Dec. 31, 1890, p. 5; Dec. 31, 1891, p. 4; Dec. 31, 1892, p. 5; June 30, 1893, p. 4; Dec. 31, 1896, p. 6; in which latter Report the increase asked for was 10 primary examiners, 50 assistant examiners, 10 clerks, 10 copyists, 10 messengers, and 10 laborers.)

Second, recommendations as to the establishment of the "Classification Division," designed to perfect the present classification of the great mass of existing patents and literature and establish a system of cross references which will facilitate and shorten the official actions of the examining corps.

(See Reports, Dec. 31, 1891, p. 4; Dec. 31, 1892, pp. 6 to 8; June 30, 1893, p. 4; Dec. 31, 1893, pp. 5 and 6; June 30, 1894, p. 6; Dec. 31, 1894, pp. 5 and 6; Dec. 31, 1895, pp. 20 and 21; Dec. 31, 1896, p. 33; in which latter instance an annual appropriation of $64,500 was asked for, covering 52 additional employes.)

It is a notorious fact that in every department of the Patent Office the employes are overcrowded to an extent inimical to health and detrimental to the good of the service, to the great inconvenience of the public having business to transact there.

The Patent Office building, built by the money of inventors, from their fees, and ostensibly for their sole use, contains also the General Land Office as well as other offices of the Interior Department.

The models have been gradually crowded out of the building, until now the once famous model room is practically a thing of the past.

In 1895 the then Commissioner thus addressed Congress (Report, December 31, 1895, p. 16): "The force of the Patent Office is scattered in remote parts of the building, its valuable records are disposed upon all the floors, and are at all times exposed to the danger of conflagrations and other loss. There is an apprehension that the galleries are overloaded beyond the safety limit, and the sanitary conditions in many of the rooms are a constant menace to health."

Other utterances will be found as follows: Reports, June 30, 1890, p. 6; December 31, 1890, p. 4; December 31, 1891, p. 1; December 31, 1892, p. 1; June 30, 1893, p. 6; and December 31, 1896, p. 34.

The Commissioners have repeatedly called the attention of Congress to the growing needs of the Scientific Library.

(See Reports for Dec. 31, 1890, p. 8; June 30, 1893, p. 5; Dec. 31, 1893, pp. 6 and 18 to 22; June 30, 1894, p. 6; Dec. 31, 1895, p. 11.)

One of the real needs of the office is a suitably equipped laboratory for chemical, physical, metallurgical and other technical and mechanical tests, and experiments in pending cases where the operativeness of mechanisms or processes, or similar questions, are involved, and can only be settled by practical tests. Such a laboratory should be liberally supplied with apparatus and material, and be in charge of skilled attendants whose entire time should be given to this class of work. Upon this subject see recommendations in the Reports of Dec. 31, 1890, p. 6, and Dec. 31, 1891, p. 10.

The attention of Congress has also often been called to the need of the Patent Office for a suitable hall in which to display its very valuable and interesting collection of models.

(See Reports for Dec. 31, 1890, p. 7; Dec. 31, 1893, p. 11; and Dec. 31, 1895, p. 17.)

General increases in salaries have been recommended as follows. (See Reports of June 30, 1890, p. 6; Dec. 31, 1890, p. 6; Dec. 31, 1891, p. 10; June 30, 1893, p. 5.)

In the Report of the present Commissioner of Patents for the year ending June 30, 1897 (Official Gazette, vol. 80, page 1613), the following language will be found: "I desire to call especial attention to the steady increase in the business of this office, and to say that if the work is not to fall hopelessly in arrears, an increase of force must be provided during the ensuing fiscal year. Such increase will be included in the estimates which I shall submit in a few days. I also lay particular emphasis upon the imperative necessity that means be provided for the improvement of our facilities for transacting the vast amount of business, which is daily expanding in every branch and division of the office." The Commissioner then recommends that Congress provide a contingent fund of $40,000 per annum to be disbursed "under the direct supervision of the Commissioner of Patents." The matter is then amplified and the pressing needs of the office set forth in very forcible terms which cannot be quoted here at length.

In conclusion, then, what is one of the most needed Patent Office reforms? Evidently a more generous appropriation by Congress of the sinews of war. Why should $300,000 per annum be collected from our inventors over and above the actual expense of running the Patent Office, and then the appropriations for annual expenses be so cut down by Congress as to materially impair the service and subject the inventors, whose fees support the bureau, to long and needless delays, working untold injury to great manufacturing interests? Why are not our inventors justly entitled to as thorough and complete a preliminary examination, and as valid a patent when issued, as money, skill, and experience can afford, and which they would long since have had if the oft-repeated recommendations of practically every Commissioner who has held office for the last twenty years had received proper attention from Congress? Why should so large a portion of the building erected by the money of inventors, for the transaction of their business, be occupied by other non-supporting bureaus to the detriment of the service? Why should their models be crowded out of the building where they most naturally belong? Why should not the bureau be provided with a laboratory and scientific and law library, each fully equipped and in every way suited to its pressing needs? Why should not salaries be increased to be commensurate with services rendered? For, as is well known, the office is full of so-called laborers at laborers' pay doing the work of stenographers and skilled clerks, of messengers at messengers' pay doing the work of assistant examiners. Were it not for such expedients as these, the office could not keep its head above water even as well as it does at the present time, but the result of all this has been, and is, to turn the Patent Office into a mere training school for clerks for other departments of government (where pay is more proportional to services rendered) and for graduates into the patent bar of the country.

An act of simple handed justice would be to turn over the Patent Office building to the sole use of the bureau serving the inventors whose money has built it; to allow the $5,000,000 already collected from them by the only self-supporting bureau of our government to be expended in bettering the service, notoriously insufficient in certain lines; for to make the Patent Office a source of revenue is simply class taxation of an especially odious kind, because burdening with a special tax the class of citizens that have contributed so largely to the industrial and other development of our country.

But wherein does the remedy lie? Evidently in the halls of Congress. I think, judging from the past, there will be no relief, or at least relief that is at all adequate, until the inventors and manufacturers of the country, one and all, take a personal interest in the matter, and use their personal influence with their Senators and Representatives in Congress to see to it that in this matter simple justice is done them. Now is emphatically the accepted time. Congress will soon meet, and the entire subject will once more be brought before that body by the present Commissioner of Patents, and pressed with all the vigor of which he is capable.

With the immediate and hearty co-operation of the real parties in interest—the inventing and manufacturing public—along the lines above suggested, very much can be accomplished for the lasting good of the country in general and its industrial interests in particular.

E. A. H.

Washington, October 28, 1897.

Death of Thomas Doane.

Thomas Doane, of Charlestown, Mass., the well known civil engineer, died October 22. He was born at Orleans, Cape Cod, in 1821, and after attending the Andover Academy he entered the office of Samuel L. Felton, a noted engineer. After remaining with him for three years he became engineer of a division of the Vermont Central Railroad. Mr. Doane was connected at one time and another with all the railroads running out of Boston. In 1863, he was appointed chief engineer of the Hoosac tunnel. He located the line of the tunnel and built the dam in the Deerfield River to furnish water power. In this work he introduced nitroglycerine and electric blasting for the first time in this country. In February, 1875, he ran the first locomotive through the tunnel. In 1869 he went to Nebraska and built 240 miles of railroad on the extension of the C., B. & Q. R.R. He made the question of grades a special study, and so perfect were those on the extension that one engine could haul as many cars to the Missouri River as five engines could haul across Iowa. When in Nebraska he took a leading part in the agitation of the question of establishing a college in that State, and in recognition of his services the institution was named Doane College.

History of Ivory.

The earliest recorded history—we might say prehistoric, the hieroglyphical—that has come down to us has been in carvings on ivory and bone. Long before metallurgy was known among the prehistoric races, carvings on reindeer horn and mammoth tusk evidence the antiquity of the art. Fragments of horn and ivory, engraved with excellent pictures of animals, have been found in caves and beds of rivers and lakes. There are specimens in the British Museum, also in the Louvre, of the Egyptian skill in ivory carving, attributed to the age of Moses. In the latter collection are chairs or seats of the sixteenth century B. C. inlaid with ivory, and other pieces of the eleventh century B. C. We have already referred to the Nineveh ivories. Carving of the "precious substance" was extensively carried on at Constantinople during the middle ages. Combs, caskets, horns, boxes, etc., of carved ivory and bone, often set in precious stones, of the old Roman and Anglo-Saxon periods, are frequently found in tombs. Crucifixes and images of the Virgin and saints made in that age are often graceful and beautiful. The Chinese and Japanese are rival artists now in their peculiar minutiæ and detail.—N. B. Nelson, in Appleton's Popular Science Monthly.

A New Tallow Tree.

The Myristica surinamensis Roland, of Guiana, and the Myristica kombo H. Bn., of Congo, furnish a grease resembling tallow in consistency, to which fact they owe their name of tallow trees. The tree which we wish to introduce to our readers, says the Revue Coloniale, does not belong to the same species nor to the same family. The tallow tree of West Africa may, indeed, be classed among the family of the guttifers, and had at first received the generic name of Stearodendron, for which subsequently that of Allanblackia was substituted.

The Allanblackia Stuhlmannii Engler, known in Usambara by the native name of msambro, is a large tree with pretty, large, fleshy flowers of a singular shape which at once attract the attention of the traveler. The fruits, which attain the size of a human head, contain a large number of seeds which are extraordinarily rich in fatty substance. According to Holst, the seeds of only four fruits furnish one kilo to one and a half kilos of grease of the spissitude of tallow. This may be used in the manufacture of candles. Quite an important trade is done in it already in Bagomoyo. The wood, of a reddish color, may be used in building, and perhaps even for cabinet making.

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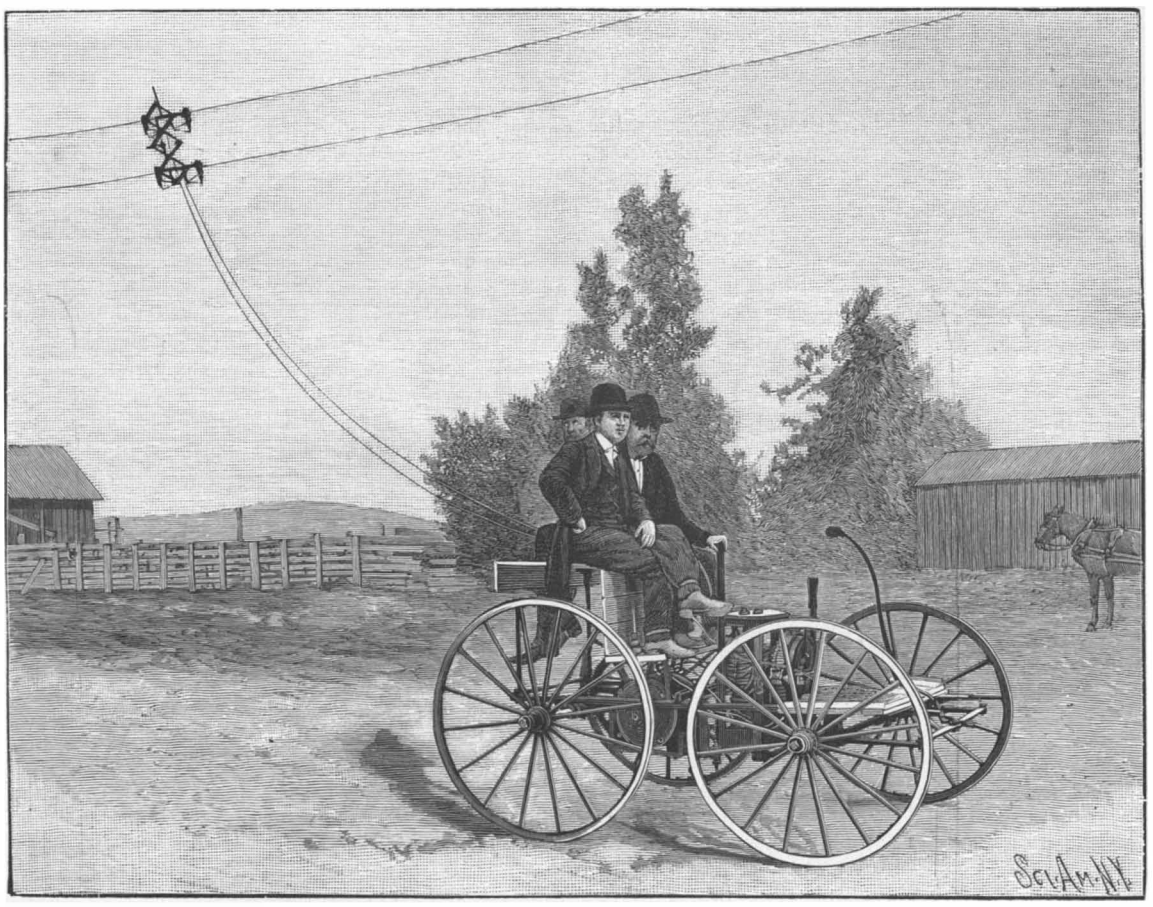
A TROLLEY WAGON FOR COUNTRY ROADS.

The subject of traction on common roads early received the attention of engineers, and many experiments have been tried to solve this interesting and important problem. The steam traction engine has been used to a limited degree, but it does not appear to have been so successful as it might be. Light automobile carriages have been used to some extent, and it is probable that in the future they will attain a considerable usefulness. The electric carriage offers advantages for use on common roads, but it is doubtful if they will prove very successful, owing to the great weight of the storage batteries, except on the most perfect roads that have small grades. The subject of the transportation of farm produce has engaged the attention of economists and even of the government. It is easy to cite statistics which show that the farmers in country districts lose vast sums annually owing to the difficulty of transporting their produce to the railroad by which it can be shipped to the consumer or exported. In England the light railway has been tried with some success, but the expense is against its more general use.



A TROLLEY WAGON FOR COUNTRY ROADS.

We illustrate a system which is certainly remarkable for its novelty and which in districts where water power is available should be very successful. The trolley electrical road wagon shown in our engravings is the invention of Mr. W. G. Caffrey, of Reno, Nevada, who has associated with him Col. H. B. Maxson. The cost of installing the overhead trolley system is not prohibitive, and where a cheap source of power is obtainable the expense of working and maintenance would not be great. Mr. Caffrey has been at work upon this system for three years, and the wagon which we illustrate has been tested successfully. A line of ordinary poles was set up near the Reno foundry and the dynamo placed therein. The two wires were secured to the poles about eighteen inches apart and seventeen feet from the ground and a trolley with a lazy tongs arrangement allowed the current to be furnished to the wagon. The problem which the inventor had to solve was a difficult one, as a perfect circuit must be maintained at all times and the contact must be flexible enough to allow a wide divergence from the regular road if necessary.

The improved form of trolley works admirably. It consists of a metallic frame having two overrunning wheels, and underneath these are the two locking wheels, which effectually prevent the top wheels from leaving the wire and still allow the frame to pass the support, holding the wire on the pole. On the lower wire a similar device is used. The two trolleys are connected by an insulated pantograph or lazy tongs equipped with suitable guides, thus providing for unequal tension on the trolley wires. The poles are 24 feet long and 6 inches in diameter at the small end. They are placed at intervals of 125 feet. On the inner or road side of these poles are two supports or "pass-bys" of malleable iron. No. 0 bimetallic wires are used. The current is supplied to the wagons by cable which runs on an automatic reel on the wagon, permitting the cable to run out 200 feet if necessary, or wind up to a short length, thus allowing the wagon to follow the ordinary road and permitting it to turn or do anything required of it. The ordinary trolley pole may also be used, but the cable permits of running the wagon on either side of the ordinary road, allowing it to meet or pass vehicles without difficulty.

The four-wheeled wagon shown in our engraving has wheels 48 inches in diameter. The rear wheels are fastened to a shaft geared to a spring-suspended motor. The motor is a two horse power one of the Westinghouse crane type. In front of the motor a commutator controller is suspended, the handle of which is within easy reach of the person steering the wagon. The front axle is trussed and the spindles are pivoted to the wheel hub, with an arm extending forward about 18 inches, fastened rigidly to the spindle. These two arms are connected, and the connecting bar again connected to the steering bar. This gives quick turning qualities with easy manipulation. The generator used was a five horse power compound wound Westinghouse 500 volt dynamo. It is said that on the trial trip a speed of fifteen miles an hour was reached with a load of 2,500 pounds on the wheels. The control of both the motor and the steering apparatus was all that was desired. The trolley moved easily over the wires and there was no difficulty with the "pass bys."

The development of the long distance power transmission and the utilization of this or some similar system will prove of great value to the farmer and those who have occasion to transport goods along country roads.

FRONT VIEW OF TROLLEY WAGON.

The Salt Habit.

The use of salt as a condiment is so general and so universally believed in as necessary that we rarely hear a word against its excessive use, but there are a multitude of persons who eat far too much salt; eat it on everything—on meat, fish, potatoes, melons, in butter, on tomatoes, turnips and squashes, in bread and on a host of foods too numerous to mention. To so great an extent is it used that no food is relished which has not a salty taste, and this hides more or less the real taste, which is often very delicate. Now, the amount of salt required in the system is comparatively small, and if the diet has been rightly compounded, very little is necessary. Some go so far as to discard its use altogether, but whether this is wise or not we will not here consider. What are some of the evils of the excessive use of salt? They are to paralyze the nerves of taste, or to pervert them so that they cannot enjoy anything which has not a salty flavor, and in addition there is a direct tax on both the skin and the kidneys in removing it from the blood. Whether the skin is harmed by this tax we do not know. Possibly it is not greatly injured, yet we know that few people possess a healthy skin; but it is now pretty well settled that an excessive use of salt does overtax the kidneys in its removal and that the great number of cases of derangement and disease of these organs is due to this use. It takes only a little time to learn to enjoy many kinds of food without salt, and we advise our readers and others to look into this matter and to try and diminish the use of this condiment as far as possible. We believe they will be better for it.—Journal of Hygiene.

AT Crevalcore, a small town situated on the outskirts of Bologna, there was unveiled on September 8 a bronze monument erected in honor of Marcello Malpighi, the celebrated Italian anatomist, botanist and microscopist, the contemporary, among others, of Hooke, Grew and Oldenburg, names famous in the early annals of the Royal Society. Malpighi's relations, indeed, with that society were close and cordial throughout. His interesting correspondence with Henry Oldenburg, its first secretary, and with men equally concerned in the "Improvement of Natural Knowledge," is carefully preserved in the society's archives.

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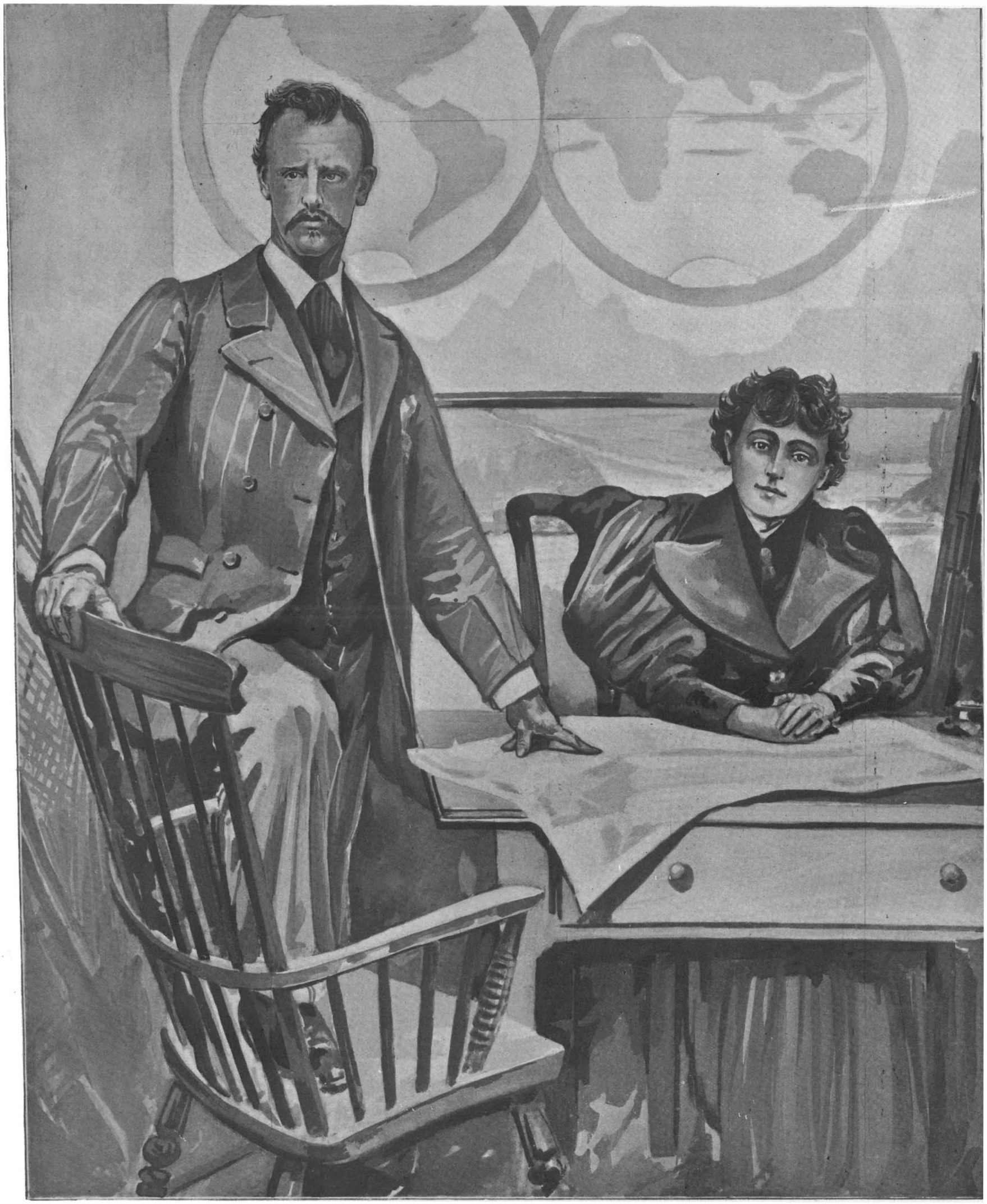
ARRIVAL OF DR. NANSEN.

Dr. Fridtjof Nansen, the Norwegian explorer, arrived in New York October 23, on the Lucania, and was met at Quarantine by the steamer Favorite, with the Nansen committee, composed of Scandinavians who live in New York, and members of the press. The distinguished explorer left the Lucania and came up to the city in the Favorite. Mr. Carl G. M. Woxen, consul for Norway and Sweden, made a speech in Norwegian welcoming the explorer to America, to which Dr. Nansen responded in the same tongue. Prof. Libbey, of Princeton, delivered a brief welcoming address and Dr. Nansen replied in English, which he spoke with apparent ease. A choral society sang Norwegian patriotic songs. The visitor was escorted to the Hotel Savoy, where he will stop during his visit to New York.

It is natural that Dr. Nansen should have been questioned as to whether Andrée was lost. The doctor said he did not think Andrée was lost, it being too early to assume this, as yet. As to his own plans, Dr. Nansen said he had none bearing on Arctic exploration. He said he had no idea of leading another expedition in search of the North Pole.

He said he did not expect to undertake the fixing of the northern boundary of Greenland, though his former captain, Sverdrup, was about to head an expedition for that purpose.

There was an enthusiastic reception for Dr. Nansen in the evening at Chickering Hall, given by the American Geographical Society. The hall was filled with people who rose to their feet and applauded the explorer as he came upon the platform. Lieut. Peary was present, as were also Sergt. Long, of the Greely expedition, and Capt. Brainerd. Dr. Nansen was introduced by Ex-Judge Daly, who then presented to him the Cullum Geographical Medal, which bore the inscription, "Awarded to Fridtjof Nansen for his voyage in the Fram and sledge journey on the ice floes to 86° 14′ north, 1893–1896." After Judge Daly's presentation speech, Dr. Nansen said he specially appreciated it, "because it is given me by a nation which has had so many great explorers." He concluded by professing his admiration for Lieut. Peary, and hoped he would reach the pole on his next expedition. Lieut. Peary and Capt. Brainerd also made brief addresses. Capt. Brainerd said: "The United States held the record for the furthest north for fourteen years. When I learned of Nansen carrying the Norwegian flag beyond the point reached by the stars and stripes it was something of a shock to me, but I was consoled by the thought that it was most fitting that the Norwegians,



DR. NANSEN'S TRIP TO AMERICA.

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the descendants of the old Vikings, should hold the record."

On October 26 Dr. Nansen was a guest at a reception given at the Arlington Hotel, Washington, by the National Geographical Society. A large number of scientific men were present, including Gen. Greely and Commodore Melville. President McKinley received Dr. Nansen in the Blue Room of the White House on the same day. Our engraving represents Dr. Nansen as he appeared in London during his lecturing tour last winter.

Mercier's Process for Eliminating Hyposulphites.

Photographic negatives or prints, says M. Mercier, are usually subjected to a final treatment by a solution of hyposulphite of soda in order to dissolve the argentic salts, which treatment is termed the fixing, after which they are washed for some time in order to eliminate the hyposulphites. Such washing often consumes a considerable time, especially when the treatment with hyposulphite of soda has been incomplete, as the negatives and prints retain in such cases an argentic hyposulphite which is insoluble in water and withstands the action of ordinary washings.

My invention relates to means for avoiding these long and tedious washings by the use of solutions prepared with the aid of iodine or iodides, bromine or bromides, in the following manner, that is to say:

1. I may dissolve in water alkaline iodide such as iodide of potassium or iodide of sodium. I have discovered that alkaline iodides decompose argentic hyposulphites contained in the negatives or prints as they are withdrawn from the fixing bath, while thus facilitating the washing of the negatives and prints to a far higher degree than alkaline chlorides, such as common salt, which had been heretofore recommended as a dialytic eliminator of hyposulphites.

2. Instead of using alkaline iodides alone, I may use conjointly with them salts having an alkaline reaction, such as carbonate of soda, sulphite of soda, sodic phosphates and the like, or an alkali such as potash soda or ammonia. I have discovered that the elimination of the hyposulphites is thus more rapid than with the iodides alone. I often add to the above compounds a small quantity of common salt, which, however, is not indispensable. As a practical illustration of the above indications, I may use a solution containing about four grammes of iodide of potassium in one liter of water, or I may use the following:

Iodide of potassium	4 grammes.
Carbonate of soda	1 "
Common salt	30 "
Water	1 liter.

I may substitute for the above alkaline iodides alkaline bromides, but in such cases the elimination of the hyposulphites proceeds more slowly.

Instead of using alkaline iodides or bromides in the solutions above named, I may prepare them directly with bromide or iodine, which method was the first employed by me, the former process having been discovered subsequently after further experiments.

To prepare the latter solutions, I dissolve iodine or bromine in a suitable quantity of water with an alkaline salt, and by perference carbonate of soda. I may use by way of example the following formula:

Powdered iodine	3 grammes.
Carbonate of soda	30 "
Water	1 liter.

To facilitate the solution of the three grammes of iodine, I dissolve them previously in forty grains of alcohol or thereabout.

I thus obtain a yellow solution which cannot be used forthwith, for it would corrode the photographic image; it is therefore necessary to wait until it becomes spontaneously discolored, which requires from one to two days or longer, or it may be discolored by heating it for a few minutes, or by adding thereto a small quantity of ammonia; when the solution is discolored and cool, it can be utilized forthwith.

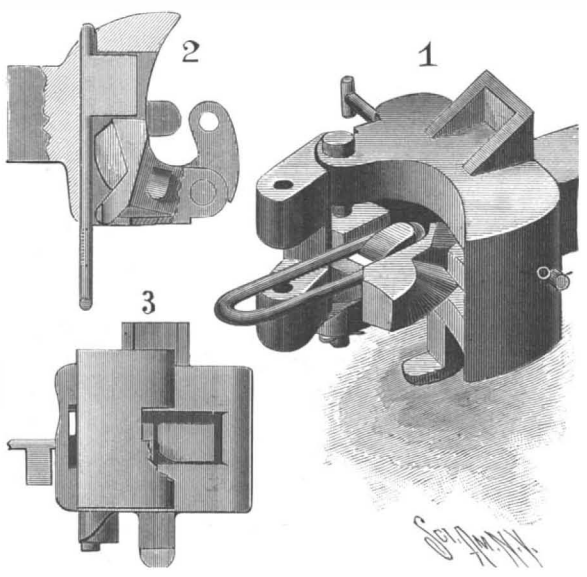
Colorless solutions of the kind above described may be obtained by adding a small quantity of sulphite of soda or by using the latter alone in lieu of the carbonate of soda, but it is preferable to use the carbonate alone, in order to prevent the introduction of sulphurous compounds in the eliminating means.

To use my solutions, the photographic negatives or prints impregnated with the hyposulphite of the fixing bath are slightly washed with water to remove the largest portion of its hyposulphites; they are then immersed in one of my solutions for a short time, varying from five minutes to one or two hours, according to requirements. The negatives or prints may be passed through several similar baths if required, the operation being completed by washing them for a few minutes in clean water.

The efficacy of my process can be readily demonstrated, particularly as regards negatives or prints which have not been left long enough in the fixing bath and are still impregnated with argentic hyposulphite, which is insoluble in water, and it is easy to ascertain when the negative or print contains no more hyposulphite by lightly touching a point of the white parts of the prints with a brush previously dipped in a ten per cent solution or thereabout of nitrate of silver, when if there be any hyposulphite left, there is formed a yellow spot at the said point.—The British Journal of Photography.

AN IMPROVED CAR COUPLING.

The accompanying illustration represents a car coupling possessing some novel features designed to afford increased efficiency in railway service, the coupling setting itself automatically ready for coupling when locked up to disconnect it from another coupling, and it being impossible for it to become uncoupled of itself, as it requires two movements to uncouple it. The invention forms the subject of a patent issued to Thomas H. Smith, of Bowie, Texas, and improvements for which application is pending. Fig. 2 is a partly sectional plan view of the coupling and Fig. 3 a front end elevation, Fig. 1 representing a coupling of this type adapted for coupling with cars provided with the old style of link and pin coupling. The drawhead is recessed from the front and has ears at one side, the tailpiece of a pivoted knuckle block swinging into the recess, and there being on the lower ear a depending lug having an incline forward of the knuckle pivot. The knuckle block also has a depending incline on the lower side of the coupling limb, adapted to traverse the incline on the drawhead and cause the knuckle block to swing open by its gravity. A transverse tripping shaft extends through an aperture in the side wall of the drawhead recess, a gravity block projecting forwardly from the tripping arm being adapted to lock the knuckle block when closed and to release it when the tripping shaft is lifted, a limb on the tailpiece being concaved on the top edge to receive the tripping shaft when the latter is raised and moved forward. The device couples closely to link and pin coupling or to the "Miller" coupling, the



SMITH'S CAR COUPLING.

link being placed vertically behind and brought down over a boss, making a close and safe coupling. It will not override or permit the coupling to fall to the track when torn from the draught timbers. The knuckle is opened ready for coupling by movement of lever, and it will couple with all vertical planes automatically. The device consists of but three parts, which may be cast into form and used as shaped in the mould, the facility of manufacturing rendering the coupling inexpensive and well adapted for general use.

Sugar and Muscular Exertion.

It is a fact well known to Alpine tourists that on difficult climbing excursions an increased desire is felt for the consumption of sweets and sweetened foods, and many who never touch such things at home devour large quantities of them on these tours. It is also frequently remarked how eagerly the guides appropriate any sugar that may be left over and consume it en route. At the instigation of the Prussian War Office, investigations have recently been made by means of a special apparatus into the question whether the consumption of small quantities of sugar rendered the tired muscles capable of renewed exertion. In order to obtain a practical result, the person who was made the subject of the experiment was kept totally ignorant of the object of the experimenters. On one day a sweet liquid was administered containing thirty grammes of sugar, on the next day a similar liquid containing a sufficient amount of saccharin to render it indistinguishable from the other as regarded taste. When a very large amount of muscular work had been performed, it was found that a greater quantity of work could be got through on the days when the sugar was given than on the days when saccharin was given. The system had become very poor in sugar, in consequence of the severe muscular effort which had previously been gone through, and hence the administration of a comparatively small quantity of sugar had the effect of producing an increased capability for work.—English Mechanic.

Science Notes.

Prof. Otis T. Mason, the ethnologist of the United States National Museum, has been honored with LL.D. by the Columbian University.

In January last, at Hanover, after a period of cold weather, there fell on the rising temperature a snow in the form of compact balls, says Science. Many of these balls were simple and completely transparent, and consisted of single, simple, spherical crystals. These are described by F. Rinne in the Jahrbuch für Mineralogie. Apparently they were crystallized rain drops, but all efforts to make them artificially were without result. They resembled the chondrites of many meteorites, and these also Dr. Rinne finds it impossible to form artificially.

It is universally admitted that one of the most important outdoor occupations in its relation to public safety and to eyesight is that of the railway service. In England the same importance in securing accuracy in this field by scientific tests is given to those employed in the mercantile marine service. In a recent parliamentary report on tests for color ignorance and form vision it was stated that in 1896 5,051 persons were examined in form vision and thirty-four failed, 5,017 were examined in color vision and fifty-one failed. Of officers already in possession of certificates, who were examined in 1896, twelve failed to pass sight tests, one master, five mates, and two second mates failed in color vision and one mate and three second mates failed in form vision.

Gen. W. W. Duffield has resigned as superintendent of the Coast and Geodetic Survey and will be succeeded by Henry S. Pritchett, Professor of Physics and Astronomy in Washington University, St. Louis, Mo. Prof. Pritchett's support came almost exclusively from his scientific colleagues, and the application on his behalf was filed in the Treasury Department without his knowledge. He was five years in the Naval Observatory and for fifteen years has been connected with the Washington University. He is only forty years old and is the youngest man ever appointed to the head of the survey. He has been connected with the work of the Coast Survey and spent a year in Japan and China conducting experiments for determining the figure of the earth. Prof. Pritchett speaks French and German and has received a number of scientific degrees from American institutions and holds the degree of doctor of philosophy from the University of Munich.

Madder root, when freshly dug up, contains about eighty per cent of moisture, but after drying for sale this is reduced to about fifteen or twenty per cent. All samples contain a large proportion of extractive substances, consisting mainly of sugary and gummy matters, starch, pectic acid, etc. As a means of generating fermentation in the indigo vat, the value of the madder is almost entirely due to these extractive matters. In madder, says Mr. W. H. Gardner, in The Textile Recorder, the coloring principle is a glucoside, rubian, which has the composition $C_{26}H_{32}O_{15}$. It was first isolated by Schunck, who prepared it thus: Fresh madder root is extracted with boiling distilled water and the filtered solution treated with animal charcoal, which absorbs the rubian and chlorogenin. The charcoal is then collected on a filter, and washed with cold water to dissolve the chlorogenin, after which the rubian is dissolved by treating the charcoal with successive portions of alcohol, obtained by evaporation of the solvent. When thus prepared it forms a dry, brittle, amorphous mass of a gummy nature. It is soluble in hot water or alcohol, but insoluble in ether, and is not precipitated from solution by metallic salts.

It is interesting to learn that a descriptive account of Sig. Marconi's "telegrafo senza fili" has been published in an official paper issued by the Italian government. The author is Prof. Angelo Banti. In the experiments at Spezia it appears that good telegrams and clear signals were got through at a distance of twelve miles. The means adopted were, it is stated, the securing to the mast of the ship, ninety feet high, a vertical copper wire, ten millimeters in section, well covered with guttapercha. One end was attached to the receiver on board, the other end was free. Another mast of like height was erected ashore, and the transmitter was attached to its vertical wire. Another mast and transmitter were also placed in the arsenal. The ships employed were two ironclad war vessels, and these were engaged for a fortnight in taking observations. In these experiments it was demonstrated that the instruments could be securely placed deep down in the hull, messages being perfectly intelligible by the receiving instrument in a cabin eight feet under water, notwithstanding its surroundings of massive iron. The vertical wire has been shown to have greater efficiency than the horizontal wire. We also learn that the invention is essentially a practical one, and the visionary notions of blowing up powder magazines and synchronizing watches are wild dreams. Many suggestions, too, of previous efforts in wireless telegraphy have been current, but from all these Sig. Marconi's invention is distinctly separated.

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THE CASTING OF ART BRONZE.

Bronze is the oldest known of all metals. We see it appearing at the dawn of humanity and following civilization step by step in all the phases of its development. It is upon it that man, scarcely having got beyond the stone age, made his first experiments in metallurgy, and the numerous objects of bronze that have come down to us make known to us quite accurately the processes in use at these remote epochs.

During this long succession of ages, the only process of any importance discovered was that of casting statues in a single piece, and which dates back to the end of the seventh century before our era. The methods that we now employ are almost exactly those used by our ancestors, the inhabitants of the lacustrine cities.

The manufacture of art bronze is divided into two parts—moulding and casting.

Moulding is the more delicate part of the operation, and upon it depends principally the success and proper execution of the piece. We are acquainted with three kinds—moulding in clay, especially employed for large bells, moulding in dry sand, the most usual process, and finally, moulding in wax, the most perfect but most costly process.

Now, these three processes were already in use in prehistoric times, as we know from objects and tools found in making excavations.

The principal drawback to moulding in sand is that in a statue the floating drapery, hair, arms and legs form as it were so many corners in the sand that interfere with the removal of the object from the mould. In most cases, therefore, it becomes necessary to divide the object of art into sections, to mould the different parts separately and afterward to unite them. This business is intrusted to the trimmers, chasers and bronze mounters. But the intervention of these different trades has the effect of injuring the artistic value of the work, since scraping produces differences in the color that can be got rid of only by the aid of a bronzing of varying thickness with glaring reflections which completely modify the value of the half tints reserved by the artist. Moreover, the chaser, often too zealous, emphasizes with his graver certain parts that the statuary had purposely left somewhat vague for the sake of concentrating attention upon the principal points of his work.

It is for this reason that wax, despite its high price, is infinitely preferable, it permitting of obtaining a casting in a single piece almost without joints.

At the epoch of the Renaissance, as in antiquity, the artist did not consider it beneath him to do the material part of the work himself. He gave the general outline by means of a clay core provided with strong bracings. This core was covered with quite a thick layer of wax in which the artist modeled the details. This wax was afterward covered with numerous coats of slip, at first very dilute and then thicker and thicker, so as to inclose the wax in a sort of gangue, both fine grained and resistant.

This done, a moderate heat sufficed to melt the wax, which, upon flowing away, left empty the space that the bronze was to occupy. After removal from the mould, one had in bronze a faithful reproduction of the work that the artist had modeled in wax.

Unfortunately, it too often happened that for various causes the bronze did not completely fill the space reserved for it, and the statue was then lost or at least much damaged. In admitting, even, complete success, there could be but one specimen of the work, without the possibility of obtaining an absolutely identical reproduction of it.

The needs of modern industry could not accommodate themselves to long and costly processes such as this, and it became necessary at any cost to substitute the workman for the artist in order to expedite matters and do the work more cheaply, although not so well. So the idea occurred to employ partial moulds for the production of small sheets of wax, which, afterward applied to a clay core and fastened together, gave, for a large number of specimens, the wax image to be reproduced in bronze. But this discovery, which was doubtless very interesting, was nevertheless inadequate to give absolutely satisfactory results. It was left to M. Le Bourg, a French statuary, to devise, in the same order of ideas, a process that was infinitely superior, from the standpoint of the results obtained, as well as from that of saving in manual labor.

Fig. 1.—MOULDING OF A WAX STATUETTE BY THE LE BOURG PROCESS.

Fig. 2.—HALF MOULD, SHOWING THE DIFFERENT ELEMENTS.

A. Plaster Shell. B. Gelatine Mould. C. Layer of Wax. D. Clay Core.

This process, briefly described, is as follows: The fact is well known that gelatine, although hard and dry when in contact with the air, softens and swells up when immersed in water, and becomes hard again upon losing its humidity. But if instead of water we employ glycerine and glucose, the elasticity will be preserved for a long time. By means of this soft gelatine, M. Le Bourg, instead of moulding the elements of a statue, moulds the latter in its entirety, surrounding it with a gelatine envelope in two pieces which is detached with the greatest ease and gives moulds of extraordinary fineness. Consequently, instead of an assemblage of elements, he obtains wax in a single piece. This done, he, by the ordinary processes of moulding in wax, covers the statue to be reproduced with slip, melts the wax and casts the metal.

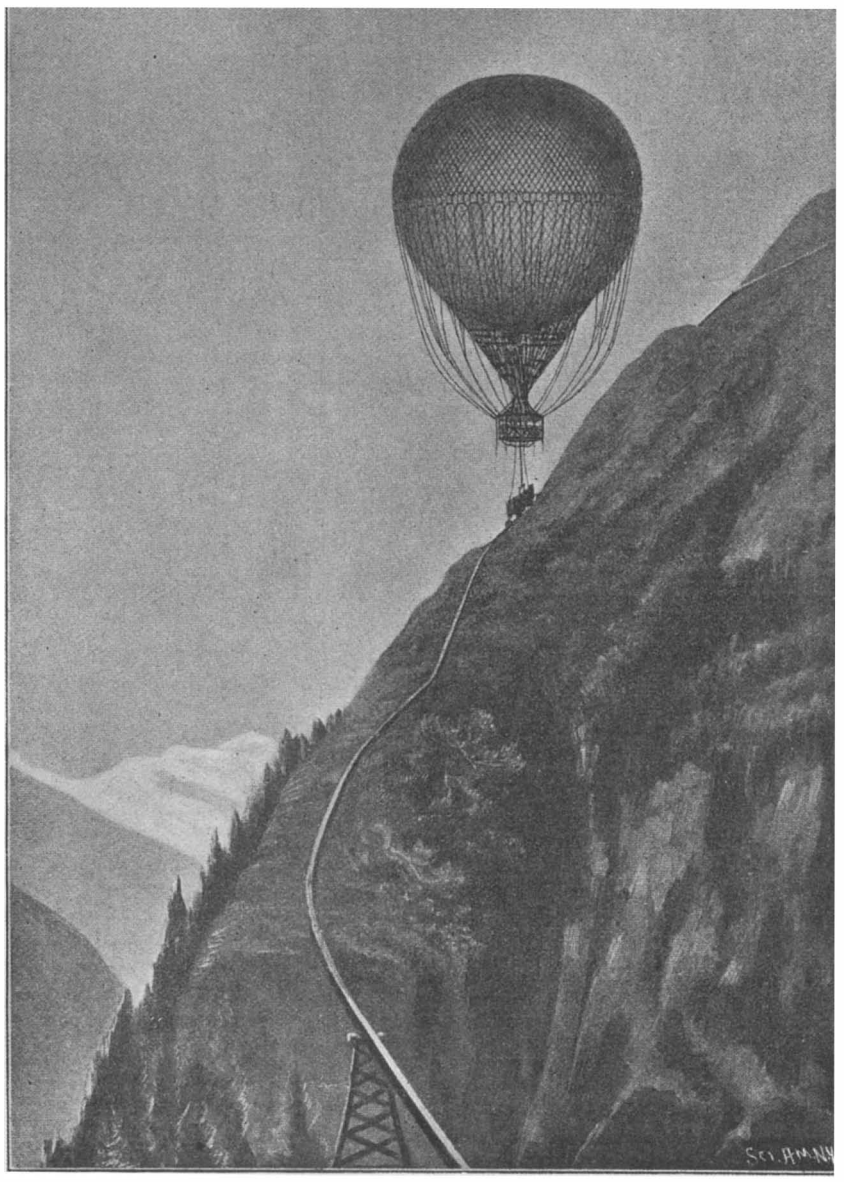
In order to manufacture the gelatine moulds, one begins by taking two moulds in plaster and working upon these so as thus to leave the original absolutely intact. One of the two moulds is scraped down superficially to a proper thickness so as to form a core that serves for obtaining a "core box" absolutely like those used in sand moulding. The second cast in plaster serves for making the mould. To this effect, one begins by covering it with a thick layer of clay, which entirely envelops it. Then there is cast over it a plaster shell, A, in two pieces. One of the halves of this having been taken off, the clay is carefully removed, so that half of the statue is thus exposed. It may be easily seen that if at this moment the half shell be put in place, there will remain between the latter and the statue an empty space, B, corresponding to that occupied by the clay just removed. This space is then filled by running in soft gelatine, which, owing to its extreme elasticity, may, at the proper moment, be taken out without ruining the model. (Fig. 2.)

Proceeding with the second half of the shell as with the first, there is obtained a gelatine impression of the second half of the statue. If, at this moment, the shell in two pieces, lined internally with gelatine, be put together, it will be seen that an exact and hollow impression of the statue to be reproduced will remain in the middle of the mould.

Let us now take a core, D, made in advance and properly dried and introduce it into the cavity in the middle of the mould. This it will occupy almost entirely and leave merely an annular space, C, that corresponds to the thickness to be given the metal. It is into this space that the melted wax is run, after which all that is to be done is to carefully remove the half shells in plaster and then the gelatine coverings in order to expose a statue that will be identical with that which an artist would have been able to model. (Fig. 1.) As may be seen, the Le Bourg process differs from the wax one only in the method employed for obtaining the wax cast, but with the advantage that the old process permitted of making but one casting, while now it is easy to have a large number absolutely identical and as delicate as those obtained by the classical wax process.

It is to be remarked that of all the operations that we have just described, none requires professional skill. Therefore, no more moulders, chasers, or mounters; and it is precisely one of the original features of the process that a bronze statue may be made without the intervention of any of the trades hitherto employed. The result is, besides, that the casts obtained have the rare merit of being an exact reproduction of the work of the statuary, whose artistic feeling is faithfully respected at every point.

We are indebted to La Nature for the engravings and particulars.



A SINGLE RAIL MOUNTAIN RAILWAY.

A SINGLE RAIL MOUNTAIN RAILWAY.

A mountain railway built on quite a novel plan was tested last year on a small scale, and is to be shortly opened in a different locality for regular service. The principal feature of the new system is that the force of traction is directed vertically upward, and is derived from a balloon. A single rail is used for the only purpose of directing the course of the train and keeping the balloon with its load captive. To this end the rail is made T-shaped, and the car runs on it, gripping it from the sides and from below. The rail is anchored to the ground at distances of about 15 feet. In the

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descent the propelling force is gravity, and the balloon acts as a check to prevent accelerated motion. A ballast of water, taken up at the top of the mountain, provides the additional downward force required. The truck carries the water receptacle, which can be opened by the aeronauts during the journey. The truck and receptacle together weigh about 660 pounds, and when there is no wind the receptacle carries about 1,100 pounds of water, making a total weight of 1,760 pounds. When it is windy the strain between the balloon and the truck is diminished by letting the water out of the receptacle, thus compensating for the difference in power. The difference in weight caused by passengers entering or leaving the car is regulated by the use of separate weights, a sufficient number of which will be kept at each station.

The tests made of this system were very favorable, and the inventors, Messrs. Volderauer and Brackebusch, are preparing to build a similar line to run up the Hochstauffen, near Bad Reichenhall, Bavaria. The inventors purpose making a balloon with a diameter of 65 feet 7 inches and a lifting power of 10,560 pounds. The balloon, car, net, rope, etc., weigh 4,620 pounds, and an allowance of 3,300 pounds is made for passengers and aeronauts, leaving a margin of 2,640 pounds.

There is a storage house where the balloon may be left in case of storm, and all possible measures are observed to insure the absolute safety of the passengers. The whole device seems very appropriate for the purpose it is to fulfill, and there seems no reason why the enterprise should not prove entirely successful.

We are indebted to the Illustrirte Zeitung for the cuts and description.

Mosquitoes.

Our readers, says Science Gossip, probably noticed the great prevalence of mosquitoes last summer, but familiar though they may be with the methods of its attack, few have any idea of the complicated apparatus with which this fly works its mischief. The beak of the mosquito is simply a tool box wherein the mosquito keeps six miniature surgical instruments in perfect working order. Two of these instruments are exact counterparts of the surgeon's lance. One is a spear with a double barbed head, the fourth is a needle of exquisite fineness, a saw and a pump going to make up the complement. The spear is the largest of the six tools, and is used for making the initial puncture; next the lances or knives are brought into play to cause the blood to flow more freely. In case this last operation fails of having the desired effect, the saw and the needle are carefully and feelingly inserted in a lateral direction in the victim's flesh. The pump, the most delicate of all six of the instruments, is used in transferring the blood to the insect's stomach.

Diphenal—a New Developer.

To the current number of the Photographische Correspondenz Dr. Julius Precht, of Heidelberg, contributes a note on this subject, an abstract of which may be interesting to our readers.

Diphenal is diamido-oxydiphenol, and is prepared from the acid extract of oxyazobenzole, and has been patented as a photographic developer by Leopold Casella & Company, of Frankfort, by whom it is placed on the market in the form of an alkaline solution, the salt itself forming white, needlelike crystals,, the solution being a dark brown color, which on dilution with water forms a nearly colorless solution, which does not stain the films nor the fingers, unless the latter are kept in the same for a very long time. It is stated to have all the conveniences of rodinal, with the advantages of pyro and iron. It gives extremely clear shadows, works very cleanly and free from fog, and gives all the delicacy and gradation of pyro. It surpasses all other developers in the latitude of exposure it allows, and with very great over-exposure there is no trouble. What it is necessary to do is to develop till the high lights are dense enough, and the shadows keep beautifully clear, more so than with any other developer except glycin.

It is specially suitable for objects with great contrasts, as it does not block up the high lights, and amateurs who are by no means certain of their exposures will find it exceedingly useful, as it so rarely gives fog. It is not a very rapid developer, the half tones and shadows succeeding the high lights in a regular manner, and not coming up simultaneously like metol, amidol and rodinal.

The stock solution is, for ordinary work, diluted with 15 parts of water for normal and over-exposure, while for under-exposure it may be used with only 8 or 10 parts of water. The brown color of the solution is not a sign of oxidation, as the stock solution has been kept for five months unchanged, and the diluted solution also keeps well. By repeated use the negatives do not, as with hydroquinone, become harder. With normal exposure and concentration the image appears in about twenty seconds, and development is complete in from five to ten minutes. With under-exposed plates, and a strength of 1:8, development may be continued for half an hour without harm. When it is known that correct exposure has been given, the developer may be used 1:10, and the image appears very quickly and development will be quite complete in about three minutes.

It is necessary to well wash the plates after development, in order to free them from the developer. If some of the ordinary fixing bath is mixed with a small quantity of the developer, the solution turns brown by the absorption of oxygen and a liquid is obtained which dissolves silver, and therefore can be used as a reducer. The brown solution thus formed also stains the gelatine. Diamido-oxyphenol can also be used without alkali as a developer—a property which is common to other para-amidophenols.—British Journal of Photography.

Firing Dynamite by Electricity.

At the Verbelia, Colorado, tunnel the dynamo used is located in the gulch twenty-five feet from the mouth of the tunnel; wires are run into the tunnel connecting with the electric caps, which, when the current is turned on, explode the dynamite. This electric cap, in construction, resembles an incandescent lamp, inasmuch as it has two wires leading into it with a filament of platinum, but it differs from the incandescent lamp filament in action. The filament in the lamp is strong enough to carry the current which makes it incandescent, and therefore gives out a steady light; but the filament in the cap is not strong enough to carry the current, but burns off, causing an electric spark to ignite the fulminating powder in the bottom of the cap and explode, thus exploding the dynamite. The wire and filament in the cap are held in place by sulphur, which is poured in while it is hot, thus making the cap waterproof. The dynamo, which connects by wires with a round of holes in the tunnel, has a pull-up or push-down handle, which is connected to the armature by means of cog wheels, which causes it to revolve at a high rate of speed, thus generating a large quantity of current, which is held in the dynamo by means of a short circuit until the armature has gained its highest speed, when the short circuit is automatically broken, allowing the current to flow through the caps and causing them to explode.

This is a safe way of exploding dynamite, says The Mining and Scientific Press, because the miner must get out of his shaft or tunnel before the current can be turned on, and, consequently, there is no danger of any of the shots going off prematurely or of any of them hanging fire; and, to be doubly safe, the miner can keep his dynamo locked and the key in his pocket.

RECENTLY PATENTED INVENTIONS.

Railway Appliances.

CAR SIGNAL.—Caroline E. Miller, Minneapolis, Minn. This invention relates especially to signaling devices for street railway cars, and provides a manually adjustable device to indicate from a car the approach of another car on a parallel track, and be plainly visible to one about to cross the track, thus warning persons of possible danger from the approach of a car that is concealed from view. The device consists of a series of foldable blades, each blade carrying an electric light, and circuit wires flexibly connecting all the lamps to a source of electricity, the blades also being painted so as to be conspicuous in daylight, and the arrangement being such that the blades may be conveniently thrown to open position or set to normal folded position.

SWITCH ACTUATING MECHANISM.—Albert D. Hill, Audubon and Tchoupitoulas Street, and John Pohlig, 3809 Tchoupitoulas Street, New Orleans, La. This invention provides for operating the switch tongues by an adjustable shifting lever carried by an engine or car, the switch tongues being pivotally connected and levers extending therefrom carrying a tappet at their connecting point adapted to operate swinging dogs. The device is of simple construction, and is designed to be readily operated when a train is going at full speed.

Bicycles, Etc.

BICYCLE CRANK MECHANISM.—Henry I. Schanck, Holmdel, N. J. According to this invention a sprocket wheel is mounted eccentrically to the axle and has oppositely projecting parts, an arm being fixed to the axle adjacent to the sprocket wheel and having a hub running around the axle, while a second arm is held loosely to the axle alongside of the hub, projecting parts of the sprocket having sliding and pivotal connection with the arms. The improvement is designed to afford means for increasing leverage in applying power through the crank arms to the driving sprocket wheel during part of its revolution, giving proportionate increase of power for the propulsion of the bicycle.

BICYCLE DRIVING GEAR.—James E. Martin, Nicholson, North Dakota. The crank shaft, according to this invention, has toothed wheels with lugs on their side faces, the pedal levers having dogs engaging the teeth of the wheel, while gearing between the levers causes the movement of one crank in one direction and the other crank in the opposite direction, dogs pivoted to the levers engaging the lugs of the toothed wheels, and rollers on a guide frame releasing the dogs from the lugs. The gear is light and strong and may be applied to bicycles of the ordinary type without requiring material change in their construction.

Mechanical.

MITER BOX.—Thomas M. Griffith, West New Brighton, N. Y. For accurately guiding a saw in the formation of mating tongues and notches in the ends of box stuff, etc., so that accurately fitting dovetail connections may be readily made, this inventor provides a miter box of inverted U-shape in cross section, and having guide kerfs extending through the top and down into the sides of the box, the kerfs being similarly inclined in parallel planes and evenly spaced apart, there being also a longitudinally adjustable gage block on the under surface of the top at one end.

OIL CUP.—Wallace E. Tillinghast, East Greenwich, R. I. This invention provides an improved vent or auxiliary valve especially applicable for oil cups for use on crank pins and other rapidly moving parts of machinery, and designed to insure a steady flow of oil, without danger of forming a vacuum to retard the flow. On the upper head of the oil cup is an improved vent or air valve adapted to open automatically and positively in an inward direction, and the casing is formed with a flared or bell-shaped mouth, which acts as a funnel on the upstroke to concentrate the air at the opening in the valve seat, thus giving to the valve the positive properties of a pump.

Agricultural.

MACHINE FOR TOPPING SORGHUM.—Truman M. Paddock, Percival, Iowa. This is a device for attachment to a wagon bed, when, as the wagon is drawn between rows of sorghum, the tops of the sorghum will be directed over the wagon and cut off. A main guide arm is curved outwardly and forwardly away from the wagon body, and guides the sorghum between itself and a shorter spring arm at the rear of which is a knife, the attendant in the wagon holding the sorghum tops and drawing them with one hand against the knife, using the other hand to lay the tops straight in the wagon.

POULTRY COOP.—Charles W. Bumpass and William M. McCandlish, Bumpass, Va. For shipping chickens, turkeys, ducks, etc., these inventors have devised a novel form of coop of skeleton frame construction, covered with wire netting, the bottom being of basket work and readily removable. In connection with the removable bottom the base frame forms an important feature, as it furnishes a comparatively rigid support for the body of the coop, and facilitates taking out and putting in the bottom.

FRUIT GATHERING LADDER AND CHUTE.—George K. Davis, Lewiston, Me. This invention provides a wheeled ladder and attached chute which may be readily changed in position to gather fruit on all sides of a tree, the chute conveying the fruit down into a suitable receptacle. The props and tongues are detachable from the axle and standards of the wheeled vehicle, and the latter may be conveniently moved from place to place, the ladder bars being used as handles of a cart in pushing the device along. The chute is so made as to protect the fruit from being bruised in sliding down.

CHURN.—John Bennett, Lyndhurst, Canada. This churn has a reciprocal dasher serving to create a current of cream around a reservoir which may contain hot or cold water to regulate the temperature of the cream. The churn has within its body portion a hollow partition to be filled with a liquid of the desired temperature, and by the operation of the dasher the cream is agitated against the dasher, the cream circulating through passages provided at the top and bottom of the partition and up and down its sides.

Miscellaneous.

EXTENSION LADDER.—Charles H. Waterman, Dayton, Washington. This ladder is mounted on a truck and operated by winding and adjusting devices also carried on the truck, the apparatus being normally kept in folded position. An endless flexible connection on the truck is attached to the ladder, the latter being pivotally connected by a link with the truck, the ladder also having a flexible connection for extending it, and there being two gearings for driving the flexible connections, a driveshaft and a clutch alternately throwing the two gearings in and out of connection with the driveshaft. The ladder is particularly adapted for use at fires, and may be provided with a water hose wound on a drum.

VEHICLE TIRE.—Angus McI. Williamson, Philadelphia, Pa. On the felly of a vehicle wheel, according to this invention, is a recessed flanged band forming a channel for the reception of the inner part of a tire, of rubber or other resilient material, this portion of the tire being united to the felly by an interior rod or bar, whose ends are secured to the felly by a loop bolt. There is a leather strip covering the rod or bar, and outside of that an air space, to insure easy riding of the vehicle, while on the tread of the tire are integral spaced projections, making the action of the wheel steplike as it travels over the ground.

ROLLER ATTACHMENT FOR SLEIGHS.—James C. Perkins, Inwood, Iowa. At each side of the sleigh are pivoted roller carrying and lifting arms, the roller-carrying arms when in vertical position supporting the sleigh upon the roller, with the runners off the ground. The arms are held forwardly inclined above the ground when drawing the sleigh over snow, but when bare ground, a bridge, etc., are to be passed over, the arms are released, when a shoe on the end of each lifting arm engages the ground to lift the sleigh upon the roller, the roller arms then assuming a vertical position and the lifting arms swinging back. By backing the sleigh, the parts are again returned to the original position, with the runners on the ground.

OIL GAS APPARATUS.—Joseph H. Baker, Brooklyn, N. Y. This invention provides a device whereby oil and steam will be perfectly mingled and atomized in an atomizer within a retort to produce a speedy and economic conversion of them into an illuminating gas. A cylindrical casing adapted to be introduced into a retort is closed at one end, and near this end is an oil inlet, while near the open end is a steam inlet, there being a distributing nozzle secured to and projecting from the open end of the casing, while a curved atomizing nozzle is secured in the steam inlet and projects into the distributing nozzle.

CARPET STRETCHER.—Joseph E. Drake, Blue Rapids, Kansas. This device affords better means for grasping the carpet to pull on it than the use of points, as in most carpet stretchers, and also affords means for temporarily holding the carpet after the slack has been taken up and until the edge can be nailed down. The body portion of the device has hinged on its front edge a clamping bar adapted to be brought into engagement with a folded portion of the carpet for the full width of the clamp, whereby the strain is evenly distributed over the entire width of the stretcher.

RAISIN SEEDER.—Cary S. Cox, Fresno, Cal. To facilitate the rapid and cleanly removal of all seeds from raisins, without danger of cracking the seeds or tearing the fruit, this machine is made with a seeding cylinder from whose periphery extend teeth, while a seed-receiving cylinder revolves in the direction of the seeding cylinder, the seed-receiving cylinder having a yielding separable surface in which are pockets for the reception of seed, the yielding surface being arranged to receive the rows of teeth on the seeding cylinder and retain the seed forced from the raisins by the teeth.

DISAPPEARING STORM HOUSE.—Richard T. Bond, Atoka, Indian Ter. As a refuge in sections of the country where hurricanes and cyclones are not unknown, causing occasionally considerable loss of life, this inventor has devised a retreat consisting essentially of a sunken pit in which is a vertical mast or post extending a little above the surface of the ground, while a cage or similar structure is adapted to slide down in the pit, the floor of the cage having a hole to receive the mast, and there being a hoisting apparatus comprising a cable guide attached to the top of the mast and winding apparatus attached to the floor of the cage. This storm house should be placed near the main house or residence, and may be made ornamental for use as a summer house, etc.

PAPER WEIGHT AND SPONGE CUP.—Ephraim Jaques, Geneseo, Ill. The body of this device may be of glass, celluloid or metal, and has a central cuplike portion, connected at the bottom with a channel leading to one side, the channel terminating in a rubber bulb, by pressing upon which water is forced up into the cup, the surplus water being withdrawn when the bulb is released from pressure.

TAG.—John G. Fisher, Hanover, Mass. This is a device especially adapted for attachment to the inside of overcoats, hats, capes and other garments, as well as upon bundles or packages, the body of the tag being preferably of metal, and the device including a fastening pin of simple form, but which will securely lock the tag in position.

Designs.

PENHOLDER SUPPORT.—Antoine H. Meloche, Whitney, Mich. This is a support adapted to be placed on a finger of the hand, to hold the pen in proper position for writing, so that the penholder need not be placed on a desk when not being used.

NOTE.—Copies of any of the above patents will be furnished by Munn & Co. for 10 cents each. Please send name of the patentee, title of invention, and date of this paper.

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Names and Address must accompany all letters or no attention will be paid thereto. This is for our information and not for publication.

References to former articles or answers should give date of paper and page or number of question.

Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.

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(7227) J. R asks: How many layers of No. 20 double-covered magnet wire shall I use to wind ring armature for dynamo core 4⅜ in. in diameter, 4 in. long, with 2¼ in. hole, composed of 23 washers, with writing paper between, all turned true and bored out? It will take about 300 turns of wire for the first layer and a few more for the next ones. What size wire shall I use for field winding, the magnet waists being 5½ in. long by 1½ in. thick, composed of sheet iron bolted together and faced up smooth? I would like to run the machine in shunt or series, if it would be better. A. For the armature use 200 turns. The number in each coil will depend on the number of commutator bars. For the field use about 1,000 turns No. 26 wire, if shunt wound. We have assumed the voltage to be 110 and the speed to be 1,600 turns per minute.

(7228) P. M. N. says: Can you inform me if there is a process other than the chalk plate by which pen and ink drawings may be reproduced for newspaper work? If so, is it more complicated and expensive? I wish to find a way to make my newspaper cuts in the simplest, cheapest and most expeditious manner, and desire to install the process in the office. Kindly let me know if there is any way of doing this, and oblige. A. We do not know of any process other than the chalk plate for producing cheap newspaper cuts. The process of photo-engraving is largely used by the New York daily papers. The effect is better than that of the chalk plate. It will be necessary to purchase some books on the subject, as Anderson's "Photo-Engraving," $5; Schraubstadter's "Photo-Engraving and Copy of Photo-Engraving," $3.25; Farquhar's "Grammar of Photo-Engraving," $2; Jenkins' "Photo-Engraving," $2, which we mail at the prices mentioned. SUPPLEMENT No. 720, mailed on receipt of 10 cents, contains formulas for working the chalk process.

(7229) F. B. H. writes: I am an old reader of your valuable paper, and I want to ask a few questions in regard to the eight light dynamo described in SUPPLEMENT, vol. xxiv, No. 600. My question is this: Can I double the drawings in every respect and get an operative machine? I mean one, if well constructed, that would answer as well as the eight light machine. If any changes are needful, please state what they are. Be sure to state size of wire for armature and field magnets, the winding being the same as in the eight light machine. Should I double the length and diameter of armature? To be short, if I were to double or multiply by 2 all the measurements given, would my machine be out of proportion? A. The sizes given in the drawings of the eight light dynamo can be doubled. This makes the machine 4 times as large. If it is wound with the same sizes and number of turns of wire as the original, it will have the same current in amperes, but 4 times the voltage. If the field is made larger, the armature should be increased in the same degree. Now, if you also use wires twice as thick, but have the same number of turns, the carrying capacity in amperes will be increased 4 times, and the total output of the machine will be 16 times as great. In place of No. 20 wires use No. 14 on armature. In place of No. 18 wire use No. 12 on field.

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OCTOBER 26, 1897,

AND EACH BEARING THAT DATE.

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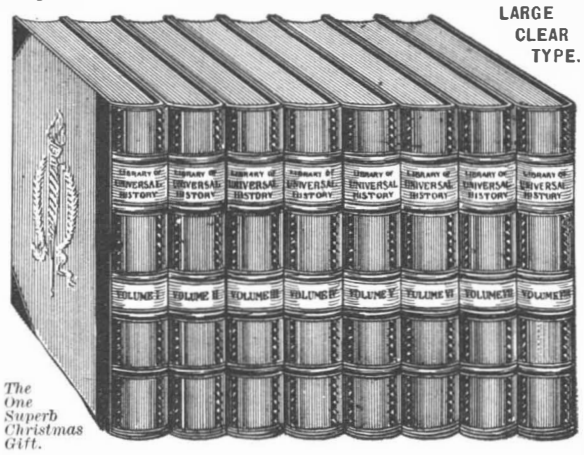

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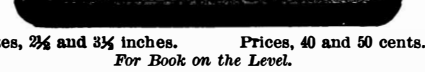

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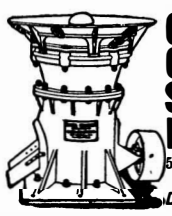

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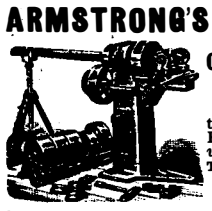

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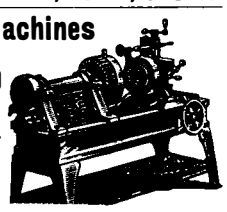

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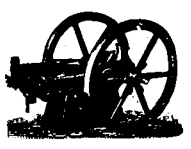

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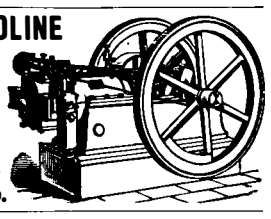

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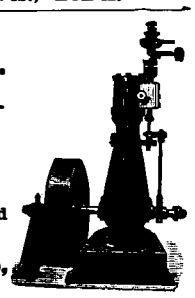

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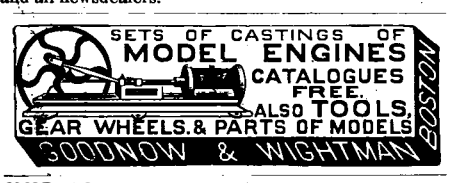

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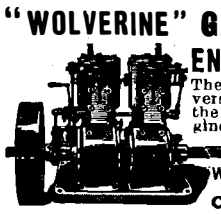

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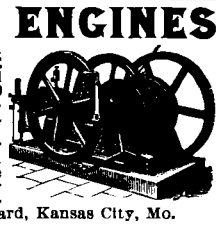

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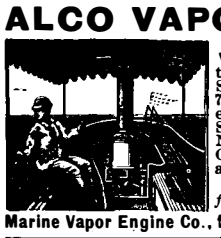

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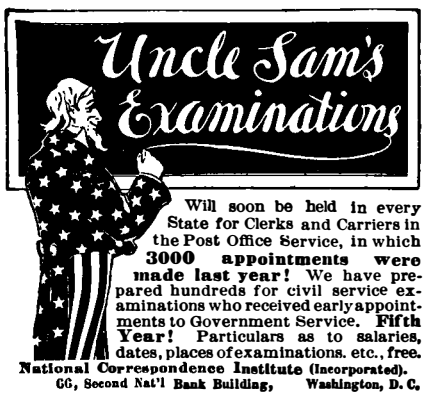

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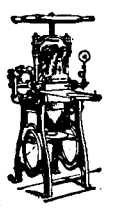

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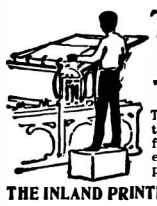

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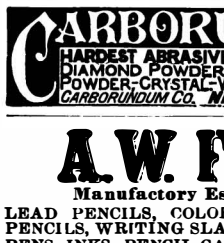

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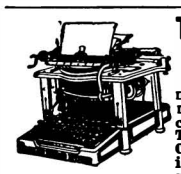

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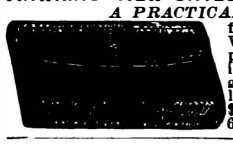

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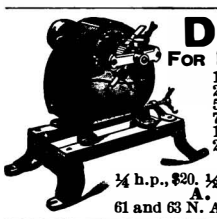

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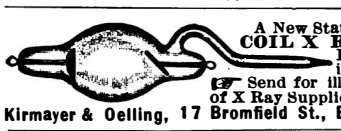

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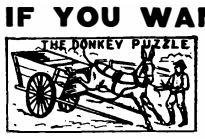

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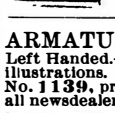

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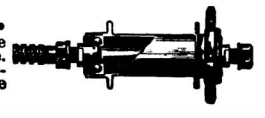

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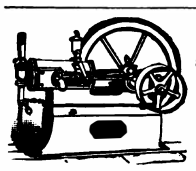

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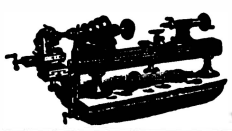

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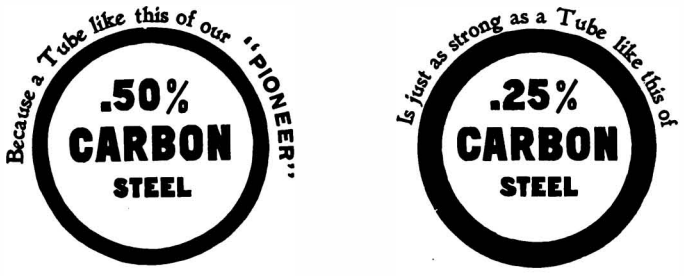

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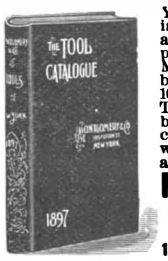

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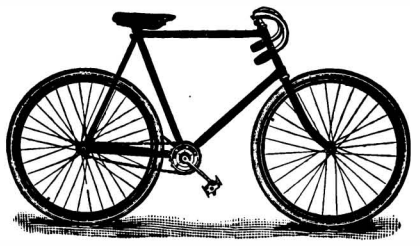

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